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"To the solid ground
Of nature trusts the Mind that builds for aye"—WORDSWORTH.

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NATURE

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SATURDAY, JULY 7, 1934

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CONTENTS

Production and Planning

GRADUALLY the industrial and commercial world is being brought round to the acceptance of the idea of the wisdom of, and the necessity for, planning. Planning is being tried in many ways and described by many names. Sometimes trade interests suffice to exercise the necessary control; more often Government intervention is necessary.

Fundamentally, the fact is that at long last it is being recognised that the excessive individualism either of a person, a firm, an industry or a country may be a danger to a nation or to the world, even to the extent of becoming a social crime. National interests are being regarded as a higher ideal than individual interests, while vested interests are viewed with increasing suspicion: the most enlightened think internationally, of mankind. The Fascists' plan to establish the corporate State with limits, within which interests may operate, laid down by the Government, is receiving increasingly serious consideration and support. The limits will be the welfare of the nation as a whole, to which all lesser interests whether of the Right or Left, whether they be employers or workpeople, bankers or other professional men, are subordinate. The 'small man' has become alarmed at the fact that the old system of government has proved quite unable in the last decade to prevent the world, and to a lesser extent Great Britain, being nearly ruined by an abundance which is produced below cost.

The combination of three factors, ample finance, applied science and industrial technique, including improved transport, has enabled the world to produce goods at an extraordinary rate: rationalisation of industry has added to the power to produce goods, but unfortunately there has been no corresponding machinery to enable the goods to be consumed.

Such ingenious attempts to solve this problem as buying by instalments or hire purchase have not really affected consumption as they have chiefly been confined to luxury articles. The outstripping of demand by production of the primary commodities has piled up a world unemployment problem of disastrous magnitude, and a vicious circle has been set up of falling prices and unemployment which is proving hard to break.

How planning can be most satisfactorily attempted is the question which awaits an answer. The form must undoubtedly vary according to the commodity. In Britain we all agree as to the danger of too much initiation, control or regulation by Government departments—a fact which has recently been acknowledged by Mr. Runciman. Business men seek beyond all else to avoid Government interference, but their freedom from this control must in return involve some obligation on their part not to over-produce.

As one illustration of the kind of thing to be avoided, what is happening in the lead industries which manufacture white lead and a variety of products from the metal may be cited. The existing old-established firms have been seeking successfully to combine into one organisation during several years past, so as to weld a previously competitive trade into an up-to-date organisation engaged in manufacture, treatment and distribution of lead products on a reasonable manufacturing scale and profit basis. Owing perhaps to the large amount of capital at present existing for which no useful outlet can be found, experimental efforts are now once more being made to establish further plants which, as the existing plants are not fully occupied, are in fact surplus. Such unregulated over-production by newcomers can only lead to disorganisation and loss of capital: it is a fallacy that new processes must of necessity show reduced production costs. The lead industry is setting a good example in going into the titanium paint trade jointly with Imperial Chemical Industries and others, instead of each company acting individually: a healthy industry giving steady employment and manufacturing economically is likely to be set up without detriment to the consumer in regard to the price he will be asked to pay.

The public is already acquainted with the restriction schemes in force for tea and tin, both of which are successfully acting to rescue these industries from impending disaster. The new international scheme of rubber control can be described as highly scientific. Its object is to restrict production so as to bring it into line with consumption and to lessen the present unduly large stocks. Having fixed export quotas for the various producing countries, these are to be maintained at 100 per cent for two months, reduced to 90 per cent for two months, to 80 per cent for two further months and then to 70 per cent. The gradual reduction avoids too great a dislocation at the plantations and likewise prevents too rapid an advance in price at the outset of the scheme which might hinder manufacturing operations. It is expected to take eighteen months at least with export quotas at 70 per cent to bring the world stocks of rubber down to normal. The scheme not only balances output as between the respective producing countries, but also between the plantations and the native small producers: it is a remarkable example of the principles of give and take in the common weal, enforced, let it be said, only with difficulty after all concerned have drunk deeply of the cup of adversity. There are no doubt faults and loopholes for evasion in such a scheme, as Sir Eric Geddes has pointed out, but it is for all concerned to carry it out loyally, for without it the rubber industry could scarcely survive.

In the future it should be possible to put through similar schemes for other commodities with less difficulty. We hold it improper for one nation to hold up any scheme which is in the interest of the world at large merely in order to bargain for better terms. It is likewise improper for a farmer who is planting a restricted acreage by agreement to increase his normal crop on the smaller area by the unusual application of fertilisers. Such action is said to be nullifying many of the attempts to improve things for the farmers in the United States. It should be regarded as unsocial, and penalised accordingly: if the individual will not work for the common good, he invites drastic action by the State.

The world is populated by human beings exercising some degree of thought and not by mechanically controllable units. Consequently

there is always an opportunity for new fields of production which have mass appeal. Salesmanship, above all the selling of new ideas, is the need of the moment, and it is the profession which is the most highly rewarded financially: it should therefore attract the best brains. Motoring, gramophones, radio, the moving and the talking picture, have in turn captured the imagination and the purses of the multitude and given rise to an immense amount of employment. Who knows what other inventions applied physics or chemistry have in store for us? The decaying industries must also take salesmanship and science into partnership as, for example, the railways and shipping. What a difference the pleasure cruise has made to our idle shipping, and the railways will find that we are travel-minded on land too if they produce the right schemes.

A form of national planning which is under trial is that presented by the trade agreements which Great Britain is making with certain countries. The basic idea in these is to ensure more certain markets for certain British commodities, in particular coal, in return for the sacrifice of lesser industries to competition with the foreigner. It is the general view of industry that in the agreements so far made we have sacrificed more than we are likely to gain and that they have been entered into without sufficient expert advice from industry and consideration of their possible repercussions. The principle of these agreements is probably a good one and only experience can enable us to pronounce on their value, but the experiment is one which is undoubtedly well worth trying; nothing is more essential than to stimulate export trade between the nations. Quotas are also an example of planning by the State, though they are best regarded as an offensive and defensive weapon in tariff wars.

Of recent years Great Britain has never been able to make up its mind whether it is to be developed as an industrial or agricultural country. Politically it is the former so far as voting strength is concerned, and it is obvious that so long as our factories could be kept fully occupied in the export trade, it was convenient and necessary as well as cheap to take most of our food from abroad. In the measure that the export trade falls, it is no longer convenient to import and pay for large quantities of foreign food, whilst national considerations of safety in war time demand that a large proportion of our food be produced at home. In consequence partly of the long period of low prosperity, the organisation of agriculture in all its branches is on a much lower plane than that of industry, and in particular the costs of distribution are unduly high; there is unnecessary wastage and an undue proportion of the profits remain in quarters where the risk and the responsibility are least.

Most of these problems are capable of being solved by planning on a county or national scale, provided that the farmer, renowned as an individualist, is prepared to join loyally in co-operative action.

This analysis is of the slightest, but it would seem clear that individualism has failed, that it must be replaced by planning for the common weal. Such planning is best done on the small scale by industries, on the large scale by nations and eventually internationally. Here science can be helpful and it must not stand aside or let itself be held aloof; the problems are bigger ones than the politicians can envisage, and their solution must profit no party end but bring employment, peace and prosperity to all. Party politics are obsolete and harmful; they must be replaced by a government concerned only with the restoration of prosperity and possessing the ability to plan economic production without putting hindrances in the way of invention.

On Caviar for the Community

(1) *Major Mysteries of Science.* By H. Gordon Garbedian. Pp. 320+64 plates. (London: Selwyn and Blount, Ltd., n.d.) 18*s*.

(2) *Electrical Conceptions of To-day: a Lucid Explanation of many of the Latest Theories concerning Atoms, Electrons and other matters relating to Electricity.* By Charles R. Gibson. Pp. 284+8 plates. (London: Seeley, Service and Co., Ltd., 1933.) 6*s*. net.

(3) *Exploring the Upper Atmosphere.* By Dorothy Fisk. Pp. 166. (London: Faber and Faber, Ltd., 1934.) 6*s*. net.

(4) *The Progress of Science: an Account of Recent Fundamental Researches in Physics, Chemistry and Biology.* By J. G. Crowther. Pp. x+304+12 plates. (London: Kegan Paul and Co., Ltd., 1934.) 12*s*. 6*d*. net.

IT is something of a commonplace to say that we might well suspend research work and devote ourselves to the formidable task of ensuring

that the products of achieved research are assimilated into the life-stream of the community. This is just as true, and just as misleading, as another commonplace about the world disease which, with an unconscious irony of bitter flavour, is called 'over-production'. If, in fact, the producers who have done their work so well could readily—and temporarily—be transformed into distributors, of equal merit, then in the wider and narrower sphere alike the world would be better off. But, in both spheres, the bravest of all new worlds would result from leaving the uniquely qualified producers to continue their beneficent work, and entrusting the work of dissemination and assimilation to other minds of quantitatively equal but qualitatively different merit.

Any newspaper will suffice to justify the adjective 'formidable' as appropriate to the task of interpreting, to the individual units of the social system, the significance of science in the life of the world, the nation and the citizen. Any bookshelf will reinforce the evidence. The radical fault lies, probably, no less in the mind of the investigator than in that of the plain citizen. It is by no accident that the epithet 'best-seller' is almost as violently abusive in relation to scientific literature as in æsthetic. The explorer has always been suspicious of the *entrepreneur*. Yet, somehow, by rational process, we must prevent a repetition, in this matter of scientific knowledge, of the disastrous history of distributive trade. Complicated though the problem be by the fact that the scientific mind is scientific only over limited tracts of subject matter, of time and of personal contact, yet its solution is vital to the advance of civilisation.

Huxley and Tyndall intrude so frequently into discussions of this kind that they must be brought into perspective. Without going back to King Charles's Head, or even to Queen Anne, one may at least say, fairly, that it is doubtful whether Huxley or Tyndall were more powerful expositors than are Jeans and Eddington; and it is scarcely so much as doubtful that they did as little to bring science *into* everyday life as do these distinguished contemporaries of ours. All four have been more valuable as anæsthetists than as physicians. The concern of everyone with a sense of the community must, at present, be less with Lethe than with the Clyde.

The four books before us are representative of four approaches to the interpretation of scientific work to the ordinary reader. All succeed in a measure of '*vulgarisation*' in the pure French sense, with no trace of 'vulgarisation' in the English sense. There is in them, that is, no trace of what an inspired reviewer once called "a plumber's dream of Paradise". But in Mr. Crowther's book alone is there any useful approach to the major problem of scientific motive and economic consequence. All four have the characteristic defects of their kind: one can pick from them gems of the customary 'modes', the plain tale, the anthropomorphic, the coyly persuasive, the roseate romantic, the rhapsodic hysteric. But since none of them pretends to be more than its title suggests, and since each honestly and interestingly conveys a truthful picture within the indicated field, they are a little unfortunate to find themselves involved in a conflict between the very different 'realities' of the metaphysicist and the politician. They merit discussion on their selected planes.

(1) Mr. Garbedian's is the least satisfactory of the four, yet it is exceedingly interesting and stimulating. "Each of the twenty-seven chapters deals with a separate distinct problem of modern science", and the problems range from sources of available energy, through lengths of human life, through cosmic radiation to cosmogony. This wide sweep is beyond the powers of any one interpreter from inside, and the lack of a completely satisfying flavour is a natural consequence of a treatment which is necessarily reporting rather than interpretation. The facts are generally accurately reported, the comments of a somewhat assorted team of authorities are cited, but there is a lack of synthesis and correlation.

(2) Dr. Gibson has an easier task, and achieves it more successfully. He has stirred a great population of growing minds to enthusiasm for "the science of to-day", and this issue in a new form of his "Modern Conceptions of Electricity" is well fitted to continue his important work in that direction. The opportunity offered by the reshaping should, however, have been used for some necessary correction and modification, for the conceptions presented are not wholly those of to-day, but of a yesterday which was in many ways more favourable to simple exposition but far less stimulating than the very thrilling to-day of atomic and philosophic physics. The particular "to-day" of this volume contained no neutron, no positive electron and no isotope of oxygen; it would be unreasonable to demand that it should have reached isotopes of hydrogen, but these intermediate advances ought to have found a

place in any 1933 printing. Up to the chosen yesterday, the conceptions are pleasingly set out; the only really misleading points noticed are the quotation of a shockingly superficial dismissal, by Dolbear, of the problem of earth currents, and the apparent suggestion, a few pages later, that the luminosity of the nebulæ is due to bombardment by electrons from our sun. These, together with the over-frequent numerical errors (as in the atomic weight of chlorine), will prove stumbling blocks on an otherwise pleasant and not hazardous path.

(3) Miss Fisk gives a lively, attractive and almost invariably reliable account of the knowledge—fragmentary though it still is—brought down from the upper atmosphere by the manned balloon, the *ballon sonde*, the sound wave, the radio wave, the meteor, the cosmic ray and the gamut of light waves. Her book is unique in its kind, and may be very cordially recommended to those who need convincing that romance is not confined to romances, nor even to bringing up the nine-fifteen. The tight-rope of scientific accuracy within universal readability has seldom been more charmingly walked.

Both the ozonosphere and the ionosphere will want reconstruction in the second edition. Miss Fisk has failed to record the scurvy trick by which the ozone workers, having enticed the acoustic workers into finding data which fitted admirably with an ozone 'layer' at 50 kilometres, have recently destroyed the fit by bringing their ozone down to much lower levels. The situation as to the structure and ionising agencies of the ionosphere is much clearer, that as to radio echoes of long delay much less clear, than Miss Fisk succeeds in making them. The blame for the defects of her discussion of these subjects must be shared with the radio-physicists. She might well, however, eliminate the suggestion that the "D layer varies in height between about 25 to 30 miles"; there is no safe experimental or theoretical basis for believing this. Clearer recognition of the distinction between 'equivalent' and geometric paths in the ionosphere would have modified the author's statements alike about the *F* layer and about echoes of long delay.

It is not easy to understand why the author rejects the officially accepted record for low temperature at ground level, − 94° F. at Verkhoiansk, Siberia, January 3, 1885, in favour of a modest − 76° F. on the Great Ice Barrier, Ross Sea, July 6, 1911, and Harang's aurora at 40 miles height has escaped mention in the appropriate chapter. These are almost the only points on which the author has gone astray, save in a very misleading juxtaposition of glowing coals and hot-wire microphones. The book is, let us repeat, novel, attractive and accurate, and our distinguished contemporary, *Punch*, had no excuse whatever for misunderstanding Miss Fisk's statement about Martian ballistics.

(4) Mr. Crowther alone offers some hold for the ponderous harpoon with which we embarked on our present fishing expedition. Mr. Garbedian's goldfish—with his frequent sporadic assertion that they may lay golden eggs—Dr. Gibson's honestly anatomical herring, and Miss Fisk's flying fish, should have been taken otherwise, but Mr. Crowther does recognise clearly that scientific culture is not a culture *in vitro*. He recognises that the æsthetic exercise of scientific research, desirable and precious as it is, cannot be understood without reference to the social medium in which it grows. "This book is intended . . . to make him [the general reader] more impatient of leaders who cannot take a scientific view of human problems." It is equally valuable in helping him to take a human view of scientific problems.

The first three chapters give fascinatingly contrasted pictures of the atmosphere of notable research institutions in England, Denmark and the Soviet Union. Later chapters proceed from the already well-explored themes of the expanding universe and stellar evolution to the less remote and less *vulgarisées* stories of penetrating radiations, the positron and heavy hydrogen. The author then turns to three chapters of biological significance, on "The Chemistry of Human Evolution", on "Human Heredity" and on "Pernicious Anæmia".

The book is full of sound fact, of scientific judgment and of stimulating comment. But the quality which sets it apart from the more superficial 'romance of science' is its steady emphasis on the interrelationship of scientific research and social environment. Mr. Crowther will help the scientific worker to realise that the 'world around us' is after all nearer our hearts than the 'universe around us'. To those who make it a demerit that he brings politics into his science he can fairly reply that this importation is the only available corrective to the older process, already disastrously advanced, of bringing the products of science—without its method or its wisdom—into politics.

The London Clay Flora

British Museum (Natural History). *The London Clay Flora.* By Eleanor Mary Reid and Marjorie Elizabeth Jane Chandler. Pp. viii+561+33 plates. (London: British Museum (Natural History), 1933.) 50*s*.

IN this noble volume recently published by the Trustees of the British Museum, Mrs. Reid and Miss Chandler describe the results of an intensive study of thousands of fruits and seeds strewn along the foreshore of Sheppey and Herne Bay by the action of the sea on the cliffs of clay in which the drifted debris was originally embedded. The London Clay, reaching in places a thickness of 500 ft., is exposed at the surface or lies beneath superficial accumulations over a large area in Middlesex, Surrey, Essex, Kent and in the Hampshire basin. In addition to remains of crocodiles, turtles, shells of *Nautilus* and other marine creatures, the clay contains innumerable samples of vegetation, mainly seeds and fruits, which grew on the northern shore of the Tethys Sea.

The authors summarise the history of our knowledge of a flora that has exercised the ingenuity of writers since the early days of the eighteenth century. The first scientific attempt to study the fossils was by Dr. J. S. Bowerbank, F.R.S., a city merchant, who in 1840 published the first part of an incompleted work. Despite the fact that his identifications were largely incorrect, Bowerbank's contribution is described as "one of the masterpieces of palæobotanical literature". More recently compiled lists, notably those by the late Baron Ettingshausen, have little value. Most of the material described in the present work is from the Bowerbank Collection, purchased by the Museum in 1865, also the Reid and Chandler and Jenkins Collections, both of which were presented to the Museum. With very few exceptions the fossils are seeds and fruits, and these, at the hands of the two leading experts in a most difficult line of research, have yielded up the secrets of their structure, their affinities to existing species, and in many instances even the manner of germination. It has been clearly demonstrated that seeds and fruits are more trustworthy records than leaves or other parts of plants.

In the introduction the authors give an account of their methods of attack; they discuss the relative importance of various diagnostic characters, and state reasons for referring certain species to extinct rather than to existing genera. Tables are given showing the geographical distribution of living representatives of the London Clay genera, and the flora is compared with others of earlier and of later date. Special attention is given to the value of fossil plants as guides to climate, and apt quotations from descriptions of tropical forests facilitate reconstruction of those which were the source of the fossil material. These and other topics of general interest are handled with conspicuous ability and with impartiality. Excluding the diatoms recorded in 1881 by Shrubsole and Kitton, 234 species are described under specific names in addition to eight species *incertæ sedis*: the named species include one *Chara*, six conifers, and sixteen monocotyledons; the rest are dicotyledons, and not a single one is considered to be identical with a living plant. The flora is composed almost entirely of woody plants (ninety-seven per cent): all the species are believed to be extinct: of ninety well-founded genera, twenty-five are recent, sixty-five extinct. One of the many problems to be solved was the degree of importance to be attached to peculiarities in structural features in deciding whether or not the differences between the Tertiary and recent species were or were not beyond a range of variation which might be expected within a single genus. Comparison of many of the fossils with their living representatives also added new links to evolutionary series.

The London Clay families are mainly, or in part, tropical: five are exclusively tropical, fourteen are almost confined to the tropics, twenty-one are equally tropical and extra-tropical, and five temperate. A striking fact is the close relationship of the fossil species with plants that are now living in "the very heart of the East Asian Tropics", mainly in Malaya. There is very little relationship with Europe, West Asia, America and Africa. Statistics based mainly on fruits and seeds from later Tertiary floras show a gradual transformation of the flora of the London Clay into floras that are definitely European. The early Tertiary vegetation represents a stage when the climate of western Europe was warmer than at any subsequent period.

It has long been assumed that the animal and plant fossils of the London Clay indicate a tropical climate. Mrs. Reid and Miss Chandler, after discussing the opinions of some other palæobotanists that the value of fossil plants as criteria of climate has been over-estimated, give their verdict in favour of the more generally accepted belief that, if a flora is considered as a whole, it is a trustworthy index of climatic conditions. In criticising

the view that in the passage of time plants may have changed in their reactions to climate, the conclusion is reached that we have no evidence of greater power of adaptability in the past than at the present day. The facts cited, though they support this view, scarcely constitute a fatal objection to the possibility—a possibility which cannot be proved—that plants have suffered a constitutional change in the course of many million years rendering them more sensitive to the effects of climate. The conclusion is that the mean annual temperature in the area now occupied by the London Clay was about 70° F.

The authors believe that many of the London Clay plants were derived from early Tertiary forests in Malaya: the close resemblance of the western European Eocene flora with the present flora of Malaya may be regarded as an established fact, but this does not necessarily imply a Far Eastern source for the London Clay flora. It is conceivable that when the Malayan genera existed in western Europe they had not reached the Malayan region. We have little exact information on the Tertiary flora of Malaya; the correctness of the authors' conclusion that the London Clay plants were wanderers from the place where their present-day descendants are living may be questioned.

The authors dismiss Wegener's hypothesis of continental drift and shifting poles as inapplicable to the established facts of plant distribution in the Tertiary and Quaternary periods. If the gradual drifting apart of America and Europe occurred as Wegener supposed, one would expect a closer relationship of floras on the two sides of the Atlantic ocean in the earlier stages of continental separation: the evidence points in the opposite direction. It may, however, be suggested that continental drift did not follow the routes postulated by Wegener: the failure of one form of drift does not necessarily invalidate the idea of a mobile crust. The authors believe that the solution of the problem can be found by altering the distribution of sand and sea in accordance with the hypothesis of Dr. C. E. P. Brooks and by assuming changes in solar radiation.

The publication of this admirably illustrated volume, embodying the results of seven years' work, is a notable event for which many readers will be grateful to the Trustees of the British Museum and to Dr. Lang, the Keeper of the Geological Department; it is a fitting recognition of the splendid services rendered to botanical and geological science by two workers whose pre-eminence in a particularly difficult and exacting branch of research is acknowledged by their palæobotanical colleagues. A welcome supplement to the present work would be a paper illustrated by a few maps and a table of Tertiary and post-Tertiary plant-bearing series giving a general account of the gradual transformation of floras and the wanderings of plants since the dawn of the Tertiary period. A. C. SEWARD.

Philosophy of Life

Religion and the Sciences of Life: with other Essays on Allied Topics. By William McDougall. Pp. xiv+263. (London: Methuen and Co., Ltd., 1934.) 8*s.* 6*d.* net.

THERE is an orderliness, a vigour and a sense of conviction about everything which Prof. McDougall writes, which secure a ready attention from his readers and often actually influence one's opinion. This is the case with more than one topic treated of in the present volume. The author tells us that the first essay, which gives its title to the book, contains the thread of thought connecting the whole; it is necessary therefore to state that a little more fully than the rest. It is this. Whereas as a youth he was an ardent student of Darwin, Spencer and other 'agnostic' writers, in later life he has advanced to a more 'religious' position, coming to think that the 'spiritual' in man has an independent existence and value, and is capable in various measures of subjugating the material aspects of the world. This is the starting point; but he goes further and asserts that in these spiritual experiences man makes contact with a real and supremely important aspect of the universe, in which he shares, being influenced by it and in return contributing something.

It will be seen that in these short pages—the essay only runs to sixteen—Prof. McDougall succeeds in raising and summarising in very effective form some of the deepest philosophical questions. It is equally clear that they cannot be adequately discussed in the few lines of a review, and we would here only note them, and note also that he seems to have come to his change of mind chiefly from meditating on the æsthetic aspect of man's activity, and that the two thinkers who have personally most influenced him are the late Poet Laureate in England and M. Bergson in France.

It is easy to understand how this religious or philosophical progress has been bound up in the author's mind with the special lines of scientific inquiry which have interested him, and which form the bulk of the essays in this volume. It is clearly akin to the form of vitalist doctrine which appeals to him. If we connect the 'spiritual' element in man's nature with that which manifests itself in all living things leading up to man, we must postulate this to be of some distinct and intrinsic value, above the physical and chemical changes which we observe in the inanimate. It is also bound up with the work of the two societies of which Prof. McDougall tells us he is an active member—he thinks the only active person belonging to both. These are the Eugenics Society and the Society for Psychical Research of which he has been the president in America, actually founding that in Boston. To find out by scientific methods the nature of the spiritual element is very properly his leading interest; and he adds to this the equally strong practical passion to increase by eugenic methods the number of efficient individuals by whom the spiritual element in the world may be transmitted and increased. His two essays on this topic, and his cogent argument for distinguishing between the eugenic and dysgenic forms of family allowances, are perhaps the part of the book which will seem to call for most immediate and detailed consideration.

On another side of his subject we know that Prof. McDougall feels strongly and will arouse a good deal of sympathy in philosophical circles; that is the need for more scientific psychology at the older universities. He urges this in an essay reprinted from the *Edinburgh Review* of 1927, and it remains substantially true at the present time. But there is one subject on which he is inclined himself to be a little less than philosophic, and that is 'race'. He often speaks, in discussing national characteristics, as if they were mainly to be connected with blood and actual descent, whereas the historian will be much readier to seek them in the historical or sociological environment by which the nation has been formed. The truth no doubt lies in a delicate balance of the two aspects; Prof. McDougall seems to tilt it somewhat on the 'racial' side which we now associate with 'Aryan' echoes.

It is almost needless to say that the book on the whole is highly stimulating and valuable.

F. S. MARVIN.

Studies in Heat

(1) *Heat*. By Prof. James M. Cork. Pp. xi+279. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 18*s*. 6*d*. net.

(2) *A Text Book on Heat*. By Dr. A. W. Barton. Pp. xiii+378. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 7*s*. 6*d*.

(3) *Heat* (*Matriculation Standard*). By Robert W. Hutchinson. Pp. vii+266. (London: University Tutorial Press, Ltd., 1933.) 3*s*. 6*d*.

(1) PROF. CORK'S treatise is essentially an advanced theoretical survey. Its scope can best be indicated by paraphrasing certain statements in the author's preface. The pioneer work of Fourier in attacking thermal problems gave solutions from which other branches of the science such as electricity and magnetism were able to profit, and the introduction of the quantum in the theory of radiation was the basis of remarkable advances in many related fields. The presentation of this newer matter together with the older classical treatment widens the scope and range of material of an adequate text surveying the whole scheme. The book aims at covering in a not too detailed manner the complete development of the subject.

Such an ambitious scheme in a book of this length obviously involves drastic condensation. Working descriptions of classical experiments are either omitted or indicated only in outline, and the same may be said of practical laboratory experiments; the book not being intended as a practical course, such experiments are only referred to or suggested.

The volume would form a good adjunct to an advanced course of lectures; it certainly has the merit of being complete rather than detailed, and contains information on almost everything which a reader could reasonably require; the presentation brings out clearly the connexion of the subject with physical chemistry and allied branches of science. To offset the condensation, very full references are given to original papers to which the student is expected to refer. A competent mathematical equipment is naturally assumed, if only to bridge the steps in the deduction of important relations and formulæ, and these again can be studied in detail, as the requirements of the reader dictate, from papers or special sources. Important recent work is included; the two concluding chapters deal with the production of high

and of low temperatures ; seven out of the remaining nine chapters end with a set of questions and problems, and an appendix of 14 pages gives tables of constants and numerical data.

(2) Before attempting a survey such as that referred to above, the student can be confidently recommended to Dr. Barton's textbook which, as the author states, has been written to satisfy the needs of those reading for university entrance scholarships and various Higher School Certificate and university intermediate examinations. At the same time, the subject is treated so as to show that the study of a branch of natural science may be genuinely cultural. To this end the scientific method and the development and "appreciation of the beauty of the rational scheme which has been created by the mind of man to explain the phenomena of Nature" are kept to the fore throughout.

With regard to the scope of the work, in addition to the form of presentation of the more elementary topics to be expected in an intermediate textbook, chapters are devoted to the kinetic theory of gases, Van der Waals' equation, cyclical operations and adiabatic changes, and the laws of thermodynamics. The possibilities of the quantum theory are hinted at in places, but are not actually introduced. The order adopted is justified in the introduction, which gives a striking logical development of the aspects of the subject, and which a student of the book should on no account omit to read. The following commendable features of the text are especially evident: new practical methods are given, historical presentation is adopted but much historical dead-weight is omitted, and the mathematical treatment is entirely up to date and extremely clear. The whole text gives a general impression of efficiency and completeness without attempting to be exhaustive, and this impression is supported by the adoption of a uniform and readable style of printing, together with diagrams well above the average in quality and clearness. In subsequent editions the index might be made considerably more detailed.

(3) The well-known style of the Tutorial Press textbooks is preserved in this thoroughly sound introductory course. While the conventional order and treatment is followed, improved practical methods and apparatus are introduced, and special attention is given to modified versions of classical experiments which can be performed by students with simplified but effective devices. It is satisfactory to note the inclusion, among others, of short sections dealing with platinum resistance thermometers and thermocouples, the equilibrium of balloons as an illustration of a practical application of the gas laws, the determination of the calorific value of fuels, and an electrical method of finding the latent heat of vaporisation of a liquid.

N. M. Bligh.

Short Reviews

The Birds of Tropical West Africa: with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. By D. A. Bannerman. (Published under the authority of the Secretary of State for the Colonies.) Vol. 3. Pp. xxxv+487+12 plates. (London: Crown Agents for the Colonies, 1933.) 22*s.* 6*d.*

With the issue of the third volume of Mr. Bannerman's great work, sponsored by the Secretary of State and by the Colonial Governments in West Africa, the project is half completed. In this volume we find the representatives of such cosmopolitan orders as the owls and the swifts, side by side with those of such purely African groups as the plantain-eaters and the mouse-birds; or we may contrast the rollers and the hoopoes, ranging widely in the Old World, with the trogons, discontinuously distributed in tropical forests from South America to Malaya. The representation is often large: for example, twenty-four species of owls and thirteen of kingfishers within the area, and sub-species as well.

The information given for each form includes a description of it and a note on its identification in the field: this is done even for familiar European species occurring as migrants, so that the work serves as a complete guide for the observer on the spot. There follows a summary of the available information as to the range, local distribution and habits of the bird, and although the data under these heads are often of necessity very meagre, they should provide both a basis for further work and an incentive to its undertaking. Questions for elucidation are abundant: the predatory methods of the fishing-owls do not seem to have been observed; the 'indicator' behaviour of the honey-guides is proved only for one species; the strange nidification of the hornbills is worthy of further study; and knowledge of the migrations of the different nightjars rests upon scanty records.

The illustrations deserve special praise. The principal artist is Mr. Henrik Grönvold, but there are also coloured plates by Mr. G. E. Lodge and the late Major Henry Jones. If one may be singled out for mention, Mr. Lodge's group of bee-eaters—five species vying with each other in the varied brilliance of their plumage—is a thing of beauty.

Publications du Bureau d'Études géologiques et Minières coloniales. *Les ressources minérales de la France d'outre-mer.* 1: *Le charbon.* Pp. iii+245. 24 francs. 2: *Le fer, le manganèse, le chrome, le nickel, l'étain, le tungstène, le graphite, le glucinium, le molybdène, le cobalt, le titane, le vanadium.* Pp. iii+436. 36 francs. (Paris: Société d'Éditions Géographiques, Maritimes et Coloniales, 1933–34.)

THESE two volumes form part of a series the aim of which is to make better known the geology and mineral resources of the French colonies. A preliminary volume, "La géologie et les mines de la France d'outre-mer", was noticed in NATURE last year (vol. 131, June 10, 1933). It was of an introductory nature, and dealt with each colony in turn, emphasising more particularly the geology of these scattered colonies. In the volumes under notice the plan differs, each material or element being treated separately. The general scheme is as follows. An adequate account of the geology of each deposit is given, illustrated by sketch maps and diagrams. This is followed by a description of the nature of the ores and the forms in which they generally occur. In volume 2, which deals with iron and metals important in the metallurgy of iron and steel, the uses and metallurgy of the several metals are discussed. Finally, with the aid of up-to-date statistics as to production, consumption and markets, the present importance and future possibilities of each deposit are summarised. Comparative descriptions are also given of world deposits other than those of the French colonies.

Many of the deposits described are at present comparatively unimportant commercially. Nevertheless, to the geologist and mining engineer the volumes are definitely interesting, since they furnish descriptions, with bibliographies, of the geology and ore deposits of a number of little-known countries, the literature of which is otherwise relatively inaccessible.

To the economist and politician the importance which some of these deposits might assume in the event of another world war may not be without interest.

The Problem of the Twentieth Century: a Study in International Relationships. By Lord Davies. New and revised edition. Pp. xvii+819+2 plates. (London: Ernest Benn, Ltd., 1934.) 21*s.* net.

IT is encouraging to find that a second edition of this masterly book has been called for, and for an estimate of its general content and purpose we must refer to the review of the first edition published in NATURE on January 17, 1931. The three years which have elapsed since then have only added to the urgency of the problem discussed, while they have given Lord Davies the opportunity of urging his solution in the House of Lords, where he spoke with the cordial though guarded sympathy of Lord Cecil and the other friends of the League of Nations and international peace. The three years since the first edition have added to the difficulties of disarmament the fresh menace of a now triumphant Nazi party in Germany. Germany has left the League of Nations because she will not submit to gentle control. Is she more likely to return, if it is armed, on Lord Davies's plan, with all the resources of scientific warfare? We allude to these things not in a spirit hostile to the book, which is an admirable summary, historical, political and technical, of the whole question of the international prevention of war, but only to show the extreme and recently increasing difficulty of applying the solution of an international police force. The most hopeful line would seem to be that indicated by Lord Cecil in the debate in the House of Lords. Concentrate on the control of the air, a sphere which is most clearly international and in which our means of action are most modern and scientific. F. S. M.

Catalogue of the Books, Manuscripts, Maps and Drawings in the British Museum (Natural History). Vol. 7: *Supplement J—O.* Pp. iv+513–967. (London: British Museum (Natural History), 1933.) n.p.

WITH this volume more than half the task of cataloguing the "supplementary" works in the Library of the Natural History Museum at South Kensington is completed. No information is given as to the period covered by this supplement, but in its earlier part it includes works published up to 1923 and in its later part to 1931. In addition, there are works of an earlier period—such as the majority of the entries under the heading of "Linnæus (Carl)", which form a valuable classified index to writings by or about the great botanist, occupying 91 pages of the book. The type is clear, the bibliographical work of the high quality which readers have come to expect in these volumes; the book will be valued as a guide to a great library of natural history, and as a general index to the natural science publications of its period.

Introduction à l'étude de l'effet Raman: ses applications chimiques. Par Prof. Pierre Daure. Pp. viii+90. (Paris: Éditions de la *Revue d'Optique théorique et instrumentale*, 1933.) 18 francs.

THIS little work gives a brief and simple, but extremely clearly written account of "one of the greatest gifts bestowed by physicists upon chemists". The five chapter headings are: molecular diffusion and the Raman effect; technique; application of the spectra to chemical analysis; interpretation of Raman spectra; and examples of chemical application. Attention is thus fairly apportioned between the practical and theoretical side. Photographs of Raman spectra are well reproduced. The examples are almost wholly confined to organic substances, and the extensive contributions made by research workers in India and the United States with the help of this rapidly developing physical weapon are almost untouched. N. M. B.

Geochemistry of Living Matter

THE chemical composition of living organisms has been studied in the past by many scientific investigators, but not in a systematic way. A new and thoroughly comprehensive approach to the investigation of the whole problem can be seen in the work of the Biogeochemical Laboratory of the Russian Academy of Sciences, under the inspired leadership of Prof. V. I. Vernadsky, whose fundamental idea is to study living matter not as something apart from so-called inorganic Nature, but as an important participant in the extremely complex chains of the geochemical processes proper to our planet. E. Suess already in 1875 proposed the term 'biosphere' for that portion of the earth's crust which contains life[1], but no attempt has ever been made to investigate the extent to which the multitudinous 'rocks' of the earth's crust are influenced by living organisms. Vernadsky is convinced that the geochemical rôle of organisms is grossly misunderstood and underrated. This fascinating problem was raised by him[2] so far back as 1918, and in 1928 a special laboratory was created for the purpose of investigating it. The enormity of the task before the laboratory makes it impossible to expect any far-reaching results within such a short period, but two reports[3,4] and a series of papers published from the laboratory contain a mass of valuable data, which can be only very briefly reviewed here.

One of the first problems before the laboratory is the quantitative investigation of the chemical composition of living organisms. In this direction, apart from card-indexing all the existing scattered information, some important data have been obtained on the fresh-water plankton (Vinogradov[3]), on a number of insects (Bergman[4]; Vinogradov[5,6]), on Echinodermata (Terent'eva[4]), etc. A general survey of this problem has been presented by Vinogradov[6,7], who points out that the data, mostly very fragmentary, exist with regard to the elementary chemical composition of only about five thousand species of plants and two thousand species of animals, which is less than 0·5 per cent of the known species. Sixty of the chemical elements have already been found in living organisms, and there are good reasons to expect that the remaining ones will also be discovered in them.

The chemical composition of various organisms is very similar with regard to such elements as carbon, nitrogen, sulphur, phosphorus, hydrogen and oxygen, but the quantity of others, such as iron, manganese, iodine, bromine, arsenic, boron, titanium, vanadium, etc., is subject to great variations from species to species. Certain organisms can be regarded as accumulators of definite elements; for example, ants accumulate manganese (Vinogradov[5,6]), Lycopodiaceæ accumulate aluminium, etc. An extremely interesting graph constructed by Vinogradov demonstrates that the chemical composition of living matter can be regarded as a periodic function of the atomic weights of elements, and the periods go mainly in sixes, so that every sixth element has a special importance for organisms. Further, it appears that organisms most ancient geologically (such as bacteria, Foraminifera, etc.) are able to concentrate a much wider range of elements, while the range of elements concentrated by the highest modern organisms (Aves, Mammalia) is very much restricted.

Another point of interest is the conclusion reached after a study of several species of *Lemna*, which proved to possess each a definite chemical composition, while the variation within each species was very small (Vernadsky and Vinogradov[9]). Hence it appears probable that the quantitative chemical composition is a specific character. Further, important data have been obtained on the presence in organisms of certain rare elements. Thus, vanadium proved to be present in some plants, but in much more appreciable quantities in Ascidia (Vinogradov[4,10]); the rubidium content of the plants *Suaeda maritima* and *Salicornia herbacea* growing on the shores of the Sea of Azov proved to be of the same order as that in the water of that sea (Burkser and others[4]). Special attention was paid in the laboratory to the concentration of radium by various species of *Lemna*, and it was found that the radium content of the water in which they grow decreases in spring when the plants show a rise in radium content; in autumn when the plants die off, radium from them again returns into the water (Brunovsky[3]; Vernadsky[11]). The problem of the carbon content in animals was studied in Acrididæ by Kunasheva[4], and some indications obtained with regard to the changes connected with the species, sex and the stage in the development. The chemical changes connected with metamorphosis in insects were investigated by Bergmann[4] in a series of species.

Another problem studied by the laboratory is the determination of atomic weights of elements obtained from living organisms. Already in 1926 Vernadsky[12] put forward a hypothesis that living organisms should possess a selective power between isotopes of an element, so that an element obtained from them should not contain a mixture of isotopes as is the case with the many elements in inorganic Nature. Technical difficulties connected with the organisation of these investigations do not yet permit the attainment of any definite results, but in the meantime Loring and Druce[13] have shown that in the potassium from potato the isotope of atomic weight 41 predominates; in ordinary potassium the chief isotope, of course, is of atomic weight 39. In the Biogeochemical Laboratory, work is in hand on the atomic weights of potassium in peas and beans, and of uranium in various organisms.

The geochemical rôle of living organisms is

obviously closely connected with the rate at which the organisms are able to assist in the migration of chemical elements in the biosphere. This rate, or the geochemical energy of living matter, depends on several specific properties of the organisms, namely, the average weight, the volume and surface of the individual, the rate of reproduction and the rate of dispersal over the earth's surface (Vernadsky[14]). Special methods have been elaborated by the Laboratory for the determination of these constants (Vernadsky[15]; Cholodovskij[3,4]).

Since the fundamental idea behind all the studies which have been directed by Prof. Vernadsky is to understand in a quantitative way the whole immensely complex series of processes connected with dynamic biogeochemistry, it is only natural that some of his publications represent attempts at building up comprehensive theories. Here belongs, first of all, his profoundly philosophical treatment of the whole problem of the biosphere[1], which one would like to see republished, since in the last few years a great number of new facts has been accumulated, and many hypotheses can be either substantiated, or modified. Another remarkable work is the history of natural waters[16], where 485 'species' of water occurring in Nature are distinguished and classified according to their genesis and properties. A general discussion on the geochemical problems in oceanography[17] represents another brilliant summary of a very difficult subject.

Scientific workers who prefer definitely ascertained facts to far-reaching hypotheses may argue that the time is not yet ripe for an all-embracing treatment of living matter as a factor in the history of our planet. No one, however, after acquainting himself with Prof. Vernadsky's work, will be able to doubt that such a treatment is not only thoroughly scientific, but also is already yielding important results bearing a promise of establishing surprising interrelations between the so-called inorganic and organic worlds. It is a matter of deep regret that most of the publications by Prof. Vernadsky and his school are in a language which prevents his views from becoming more widely known amongst biologists, chemists and geologists, for all of whom they open new and promising fields of study. B. P. UVAROV.

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[7] *C.R. Acad. Sci. Paris*, 1673; 1933. *Priroda*, No. 8–9, 1933; 1933.
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Origin and Nature of the Association between Invertebrates and Unicellular Algæ

By PROF. C. M. YONGE, University of Bristol

THE widespread occurrence of zoochlorellæ or zooxanthellæ within the tissues of invertebrates is now universally recognised, the extent of knowledge on this subject up to 1930 being well summarised by Buchner[1]. Nevertheless the actual nature of this association, or rather of the many forms which this may take and the connexion between these, is greatly in need of clarification. It is unfortunate that of the many workers in this field none, save Brandt, one of the earliest, has studied conditions in more than one or two groups. My own work on the comparative physiology of digestion and on symbiosis between zooxanthellæ and Anthozoa and Mollusca, together with a critical examination of recent, largely experimental, work on this type of symbiosis, has enabled me to throw some light on the origin and nature of this association.

Association with unicellular algæ is almost certainly confined to animals which digest intracellularly. This has been suspected by many workers, but confirmation has had to await the full elucidation of the conditions of digestion throughout the invertebrates (see Yonge[2] for a summary of the present state of knowledge). Unicellular algæ occur in Protozoa, Porifera, Cœlenterata, Ctenophora, Turbellaria, Rotifera, Gastropoda and Lamellibranchia, all of which digest intracellularly. The conditions both of symbiosis and of digestion in Polyzoa and Echinodermata require further investigation. Zooxanthellæ do occur in compound Ascidians from tropical seas as recorded, for example, by Hastings[3] in a number of species collected by the Great Barrier Reef Expedition, but Mr. H. G. Smith, to whom I recently gave these for examination, finds that the algæ are confined to the common test and never occur in the actual tissues. Berkeley[4] has recently definitely established that a green flagellate occurs in the Chætopteridæ which, like all Annelida, digest extracellularly. The work of Wilson[5], who found indications of intracellular digestion during the metamorphosis of *Owenia*, affords a possible explanation of the origin of this association.

A survey of the animals which contain algæ reveals that some of these are carnivores, notably the Cœlenterata, the Turbellaria and those Gastropoda which harbour algæ, while the others are omnivorous or definitely herbivorous, such as the Protozoa, Porifera and Lamellibranchia. The association with algæ would appear to have arisen in different ways in these two groups.

In the carnivores (Cœlenterates, in particular, are such specialised carnivores that they will neither accept nor ingest plant matter) the association was originally probably one of parasitism by the plant. This is strongly indicated by the very beautiful work of Gœtsch[6] on the association of algæ (Chlorellæ) with the Hydrida. *Pelmatohydra* and *Hydra circumcincta* never contain algæ. Spontaneous infection by algæ has been observed in *Hydra vulgaris*, and Gœtsch was able to bring about artificial infection and maintain this so long as conditions remained suitable for the algæ, which were, however, confined to certain parts of the body. In *Hydra attenuata*, artificial infection was easier, and the algæ spread more extensively throughout the tissues, becoming increasingly difficult to dislodge as time passed. Finally, according to Gœtsch, they so affect the tissues of the host animal as to form a new race, *Hydra viridescens*, where the association may be regarded as a true symbiosis. In both *H. vulgaris* and *H. attenuata*, infection is preceded by an enfeeblement of the animals and is accompanied by pathological symptoms indicating a definite parasitism by the plant. In *Chlorohydra viridissima*, there is a permanent and normal association with algæ, which are extremely difficult to remove experimentally from the tissues, the colourless animals so obtained being very easy to reinfect and actually taking in other algæ (*Oocystis*) if Chlorellæ are not available. In *Chlorohydra* alone are the algæ transmitted from generation to generation by way of the egg.

Gœtsch's work probably gives the key to the final establishment of symbiosis between carnivorous animals and algæ. An initial stage of parasitism by the plant is followed by the establishment of tolerance by the animal and later, as in *Chlorohydra*, the algæ are normally always present. Nevertheless, as Gœtsch and Van Haffner[7] have shown, *Chlorohydra* can, under appropriate conditions, flourish when deprived of the algæ. Van Haffner has shown that very similar conditions prevail in the freshwater Turbellarian, *Dalyellia viridis*. Further examination of conditions in the Cœlenterata and the Turbellaria reveals that one of two things may happen. The animal may become dependent on the plant, which still remains capable of an independent existence, or the plant becomes dependent on the animal, being specialised exclusively for life within its tissues, while the animal continues to feed normally.

The first of these alternatives is exemplified in the well-known case of *Convoluta roscoffensis* (Keeble and Gamble[8]) where the animal finally ceases to collect food and preys on the contained algæ which, though they become modified within the tissues of the animal, are members of the free-living genus *Carteria*. *Convoluta paradoxa* (Keeble[9]) occupies an intermediate position between *Dalyellia* and *C. roscoffensis*. The second alternative is exemplified by conditions in the reef-building corals (Yonge and Nicholls[10,11]) where the zooxanthellæ are never found free in the sea, have apparently lost the capacity for sexual reproduction, and have acquired a very thick cellulose wall. The animals are not only capable of feeding normally, but actually display all manner of adaptations for this. They certainly *never* digest the zooxanthellæ. Similar conditions probably prevail throughout the Anthozoa (and possibly the Scyphozoa), the opposite conclusions of Brandt[12] for anemones being open to question (his results are being reinvestigated).

Turning to the origin and establishment of symbiosis in herbivorous animals, the best indication of the preliminary stages appears to be furnished by the work of Van Trigt[13] on the Spongillidæ. Here the algæ (*Pleurococcus*) are taken in by the collar cells and passed into amœbocytes. Under favourable conditions they maintain themselves for a time but, should other food fail, they are quickly digested. The algæ are apparently capable of no more than prolonging existence for some time under conditions in which other algæ are immediately killed and digested. An increased resistance to the digestive activities of the animal may well have led to the establishment of conditions such as those recorded by Pringsheim[14] and Parker[15] in *Paramecium bursaria*. Here a very well-balanced condition has been established, the infected animals being capable of existing in the light autotrophically for a long period, so long as the necessary nutrient salts and calcium are present. Only in extreme cases are the algæ digested by the animal, which is, however, capable of living without them, feeding on algæ, bacteria and especially yeasts.

Symbiosis may also be established by the transference of an alga, already specialised for such an existence, from one type of animal to another. Naville[16] has recorded the interesting case of the Nudibranch, *Æolidiella alderi*, which feeds exclusively on the Actinian, *Heliactis bellis*, which contains zooxanthellæ. Not only are the nematocysts in the cerata of the mollusc identical with those of the anemone but also the same zooxanthellæ flourish in the ingesting cells of the 'hepatopancreas'. The zooxanthellæ in the test of compound Ascidians (which appear to be identical with those of corals and other reef-dwelling Anthozoa) may well be derived in the first place from those contained in planulæ, being in some manner incorporated in the common test during the growth of this. In the Tridacnidæ, where is found one of the most striking cases of dependence by animals on contained algæ, the animal literally 'farming' the plants in the thickened mantle edges (Yonge[17]), the zooxanthellæ may also in past time have been acquired from planulæ.

A study of the nature of the association as it exists in different animals at the present day reveals, as the foregoing account has already indicated, many gradations. This can most conveniently be reviewed by discussing first the possible advantages gained by the algæ and then those gained by the animals.

The algæ obtain protection once they have succeeded in establishing themselves. They obtain

ample supplies of carbon dioxide, which would probably always be available, but, more important, also of nitrogen and phosphorus. Many of the early workers in this field emphasised the significance of 'nitrogen hunger' in the sea, but this is no more important, as we now know, than 'phosphorus hunger'. In the reef-building corals, not only is all the phosphorus liberated by the animals immediately utilised by the zooxanthellæ, but phosphorus is also taken from the surrounding water even though the content has been artificially increased to a very high figure (Yonge and Nicholls[10]). The algæ in *Convoluta* can utilise uric acid or urates, but these algæ when living free in the sea may normally feed saprophytically.

In other cases also the algæ appear capable of existing to some extent saprophytically within the bodies of the animals. Thus Pringsheim has found that the Chlorellæ in *Paramecium bursaria* not only survive but also may actually increase in darkness, provided that the animals are well fed. Since the algæ cannot photosynthesise under these conditions, it is clear that they must obtain organic matter from their hosts. Van Haffner has come to similar conclusions in his work on the Chlorellæ contained in *Chlorohydra viridissima*. He states that they may increase in darkness and that they are always especially numerous and increase most rapidly in those regions of the animals where carbohydrate is most abundant. In correlation with this tendency to saprophytic nutrition he finds that the Chlorellæ within the animals have smaller pyrenoids than those which are free-living. The conditions here, therefore, are somewhat akin to those in *Convoluta roscoffensis*.

The advantage which the association brings to the animals also varies very greatly in different cases. In the presence of light, oxygen is continually being formed by the algæ. In corals and other Anthozoa this may, during the middle of the day, be greatly in excess of the amount used by the animals and plants in respiration (see Yonge, Yonge and Nicholls[18]). But it is noteworthy that few workers, though all have mentioned the production of oxygen, lay much stress upon it. Though it has been proved in many instances that, under experimental conditions, 'green' animals will survive for longer periods in deoxygenated water in the light than will 'colourless' animals of the same species, yet it is almost universally admitted that such conditions would seldom, if ever, be encountered by the animal in Nature.

There is also universal agreement that the plants make use of the end-products of animal metabolism, notably carbon dioxide, nitrogen and phosphorus, and that this automatic removal of excrement may be of great advantage to the animal. There can, as already stated, be no doubt that this occurs, though its actual significance in the life of the animals is more difficult to assess. In *Convoluta roscoffensis* and *C. paradoxa* its great significance is placed beyond question by the absence in these animals of organs of excretion. In Protozoa, Porifera and Cœlenterata organs of excretion do not occur, so that this test cannot be applied. I have previously summarised in NATURE (Yonge[19]) my reasons for thinking that, though individual corals can live well without contained zooxanthellæ, yet, because of the help they give by automatically removing the end-products of metabolism, the zooxanthellæ are "probably an indispensable factor in the necessarily exceptional powers of growth and repair possessed by the marine communities known as coral reefs".

The most disputed point of all is the extent to which the algæ provide food to their hosts. The animal may obtain food from them in one of three ways. In the first place, organic matter (notably fats and carbohydrates) may pass from the living algæ to the tissues of the animal. Pringsheim has shown that this must be the explanation for the autotrophic mode of life possible to green *Paramecium bursaria*. Brandt[20] came to similar conclusions in his work on colonial Radiolarians, stating that starch passes from the living zooxanthellæ into the protoplasm of *Sphærozoum*, *Acanthometra* and *Siphonosphæra*. Famintzin (quoted by Buchner), on the other hand, thought that this starch was derived from degenerating algæ. This matter requires, as Buchner has observed, further investigation. In *Chlorohydra* Gœtsch has shown that green individuals will survive starvation in the light for about four months, whereas colourless individuals live for only half this time. He inclines to the view that organic matter, in particular fat, is passed from the algæ to the animal under such conditions, but Van Haffner comes to the opposite conclusion both for *Chlorohydra* and *Dalyellia*. He does think, however, that degenerating algæ may be used as food by the animal. In *Convoluta roscoffensis* and *C. paradoxa* there is an undoubted passage of fat from the algæ to the tissues of the animals, during the early stages of the association. Keeble and Gamble have figured the process and I have myself prepared sections of *Convoluta roscoffensis* which confirm their statements.

The second alternative is that the animals digest the algæ after these have, for some reason or other, probably starvation, died in the tissues. Van Haffner is the only author who has laid great stress on this, but it may be of considerable significance. It does not, however, follow that a degeneration of the algæ necessarily means that they are digested; for in corals, degenerating algæ are continually being ejected from the body of the animal by way of the mesenterial filaments (and the process can be very greatly increased by subjecting the corals to excessive heat, lack of oxygen or starvation) but these are *never* digested. A starved coral will live no longer in light than in darkness (Yonge and Nicholls[11]).

Finally there remains the possibility that living algæ are killed and digested by their hosts. In extreme cases this occurs, according to Pringsheim, in *Paramecium bursaria*. In the Spongillidæ it continually occurs, as Van Trigt has shown, while I have found that it is an equally normal process

(and a more essential one) in the Tridacnidæ. But all of these animals are naturally herbivorous and the powers of resistance to digestion by the algæ are limited, particularly in the Spongillidæ. In *Convoluta roscoffensis* and *C. paradoxa* the algæ are certainly digested, the former species finally losing the power of feeding altogether, and becoming completely parasitic on its contained algæ. This appears to be the only case of an animal which becomes completely dependent on the algæ for nutrition.

Several points of interest emerge from this discussion on the possible food value to the animals of the algæ. One is that in herbivorous animals the power to resist digestion by the animal entails specialisation on the part of the algæ (for example, in *Paramecium bursaria*); another is that the ability to feed on the algæ represents a specialisation on the part of the carnivorous animals such as *Convoluta*, though in this case the absence of a cellulose wall around the algæ is possibly of significance. The presence, on the other hand, of an exceptionally stout cellulose wall around the zooxanthellæ of corals and other Anthozoa possibly explains the inability of such animals to obtain nutriment from these even after they have died in the tissues. In *Tridacna*, where the zooxanthellæ are otherwise very like those of the corals, I have been unable to find so thick a cellulose wall. The passage of organic matter from the algæ to the host, as in *Paramecium* and *Convoluta*, probably involves specialisation by the plants, but it also indicates that these are in a position to produce more food than they need themselves for maintenance and multiplication. In the corals the endoderm is invariably packed with zooxanthellæ (as many as 25,000 may occur in a single planula of *Pocillopora*) and these increase as the coral grows. There is never likely to be any superfluity of food under these conditions; indeed, as already stated, the zooxanthellæ will extract phosphorus from the surrounding water.

This summary will have indicated, if nothing else, that the nature of the association between animals and unicellular algæ varies greatly in different cases. If by symbiosis is meant only a relationship which is mutually advantageous to both parties, then the only adequately investigated cases which meet this requirement are *Paramecium bursaria*, *Chlorohydra* and the reef-building corals (and probably all Anthozoa). In every other instance, one party in the association is exploited in some measure by the other.

In conclusion, I wish to record my thanks to the Royal Society of London for a grant which has assisted the investigations from which many of these conclusions have been drawn, and also to Mr. H. G. Smith for kindly permitting me to mention the results of certain unpublished work.

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Obituary

PROF. A. P. CHATTOCK, F.R.S.

PROF. ARTHUR PRINCE CHATTOCK, emeritus professor of physics in the University of Bristol, died at his home in Clifton, Bristol, on July 1 at the age of seventy-three years. Educated at University College School, University College, London, under Carey-Foster, and at Stuttgart, he started his career as an electrical engineer in the firm of Siemens. In 1885, however, he was appointed as the first lecturer in physics in University College, Bristol. He spent the following year in Liverpool under Sir Oliver Lodge and then returned to Bristol to take up the duties of a newly created chair in this subject.

From 1887 until 1910 Prof. Chattock was known to a generation of students of physics at Bristol as an inspiring and self-sacrificing teacher, and to his contemporaries as an experimenter who, despite meagre facilities, carried out pioneer work of the first rank. Among these researches may be mentioned that on the mobility of gaseous ions, and the Chattock-Fry pressure gauge originally designed for the work of Stanton on the wind pressure on structures, and later incorporated in wind tunnel measurements. An ingenious magnetic potentiometer devised by him deserves notice, as also an attempt, though negative in result, to verify Weber's theory of electromagnetism.

The foundation of the University of Bristol in 1909 brought additional responsibilities to his office. Modest and retiring almost to a fault, Prof. Chattock felt that he could not face them, and to the great regret of his colleagues, both lay and academic, he retired from his post to live in the country. There he stayed for ten years, engaged in poultry farming and on work for the Ministry of Agriculture on the physics of incubation.

In 1920, however, Prof. Chattock was induced to return to the University laboratories for a few years under the terms of his emeritus professorship, with facilities for continuing his researches in physics. In this later period, he carried out with L. F. Bates a classical determination of the gyromagnetic effect in iron. This, coupled with later work by Bates and Sucksmith, and more recently on paramagnetic substances by Sucksmith in the

Bristol laboratory, has had important consequences in the study of modern physics. He was awarded the honorary degree of D.Sc. by the University of Bristol in 1911, and was elected a fellow of the Royal Society in 1920.

DR. T. G. PINCHES

WE regret to record the death of Dr. Theophilus Goldridge Pinches, the distinguished Assyriologist, which took place at the age of seventy-eight years, at Muswell Hill, London, on June 6. Dr. Pinches originally was engaged in his father's business as a die-sinker; but, taking up the study of cuneiform inscriptions, he joined the staff of the British Museum in 1878, retaining that position until 1900, when he retired on pension. He was lecturer in Assyriology at University College, London, and in the University of Liverpool, resigning the latter post, owing to ill-health, only a year or two before his death.

At the British Museum Dr. Pinches' work was especially noted for the beauty of his copies of cuneiform texts. He was responsible for the text of parts of vol. 5 of the "Cuneiform Texts from Babylonian Tablets" and "Cuneiform Inscriptions of Western Asia" published by the Museum; and he compiled a guide to the Nimroud Saloon. For many years, Pinches was one of the foremost workers among the group which included Sayce, Thureau-Dangin and Bertin. He was recognised as an expert in the Assyro-Babylonian and Sumerian languages and had studied Hebrew, Aramaic, Ethiopic and Arabic. He was especially active in connexion with the work of the Society of Biblical Archæology, the periodical publication of which contains a large number of contributions from him. He was also its editor. For some time he was a member of council of the Royal Asiatic Society.

A very long list of books, monographs and papers on Assyriology stands to Dr. Pinches' credit. He edited and translated the Amherst tablets (1908), the Berens Collection (1915), and the texts belonging to Sir Henry Peek (1888). He also contributed translations to "Records of the Past" (second series). One of his most interesting discoveries was the bilingual story of the Creation which was published in "The Old Testament in the Light of the Historical Records of Babylonia and Assyria" (1908). Among his works of a more popular character may be mentioned "Religion of Babylonia and Assyria" (1906).

WE regret to announce the following deaths:

Mme. Curie, professor of general physics in the Faculty of Sciences at the Sorbonne and director of the Laboratoire Curie at the Institut du Radium, Paris, known for her work with her husband, Pierre Curie, leading to the discovery of radium, and for subsequent researches on radioactivity, on July 4, aged 66 years.

Sir James Fowler, K.C.M.G., K.C.V.O., consulting physician to the Middlesex Hospital, formerly dean of the Faculty of Medicine, University of London, on July 3, aged 82 years.

News and Views

Honorary Members of the Royal Society of Edinburgh

ON July 2, the following were elected honorary fellows of the Royal Society of Edinburgh to commemorate the completion of its 150th year: *Foreign*, Björn Helland-Hansen, Geophysical Institute, Bergen; Prof. Bernardo Houssay, professor of physiology, National University of Buenos Aires; Prof. Frank R. Lillie, professor of zoology and embryology, University of Chicago; Prof. T. H. Morgan, professor of biology, California Institute of Technology, Pasadena; Prof. Paul Sabatier, professor of chemistry, University of Toulouse; Dr. Theobald Smith, formerly director of the Rockefeller Institute for Medical Research, Princeton, New Jersey. *British*, Prof. H. E. Armstrong, emeritus professor of chemistry, Imperial College of Science and Technology, City and Guilds (Engineering) College, London; Prof. J. S. Haldane, director of the Mining Research Laboratory, and honorary professor, University of Birmingham; Prof. Karl Pearson, emeritus Galton professor of eugenics, University of London; Prof. E. B. Poulton, lately Hope professor of zoology, University of Oxford; Sir G. Elliot Smith, professor of anatomy, University College, London; Prof. W. W. Watts, emeritus professor of geology, Imperial College of Science and Technology, London.

Dr. Robert J. D. Graham

THE newly elected professor of botany in the University of St. Andrews, Dr. Robert J. D. Graham, is a native of Perth. He was a student in the University of St. Andrews at University College, Dundee, and at the United College. He graduated at St. Andrews in arts and science and held at the University a Carnegie research scholarship in botany. He spent eleven years in the Indian Agricultural Service, where he did important administrative work as economic botanist to the Government of the Central Provinces in organising botanical study, plant-breeding, etc., in these Provinces. He was granted the degree of D.Sc. by the University of St. Andrews for a thesis on "The Economic and Systematic Botany of the Central Provinces, India". During the War he served in Mesopotamia and was released from military service in 1920 with the rank of Lieutenant-Colonel. When, in the following year, he retired from the Indian Service, he was appointed to a post in the Botany Department of the University of Edinburgh and he has been attached to that Department until now under the late Sir Isaac Bayley Balfour and Sir William Wright Smith. He has had an extensive and varied experience in the teaching of students of botany. A long series of

contributions to botanical science stands to his name in the transactions of botanical societies and journals as well as in the Government publications of India and Mesopotamia. The practical aspect of his work in relation to the propagation of plants and the combating of plant-diseases in India, in Mesopotamia, and in Great Britain has been widely recognised.

The Chinese Mitten Crab

THE Chinese mitten (or woolly-hand) crab, *Eriocheir sinensis* (see NATURE, June 9, p. 855), was transported to Germany from China in some unknown way and was first caught in the Aller (a tributary of the Weser) in 1912, but was not identified until 1923. It has spread widely in the river systems of Germany—the Elbe, Weser, Rhine and Oder. It is stated that about 700,000 of these crabs were caught in 1931 at Hamburg; the crab has in fact become a pest in some places. The adult crabs wander down the rivers at the beginning of the breeding season; pairing takes place in brackish water of the lower Elbe and Weser, but the crabs bearing eggs are found off the river estuaries in more saline water. In the interests of controlling the crab, Dr. W. Wolterstorff, of the Magdeburg Museum, has addressed questions to the Peking Society of Natural History. These and the answers are contained in the *Bulletin* of the Society, vol. 8, Part 3, March 1934. Dr. Wolterstorff refers to a report that the crabs were cleared out of the lower Liang Ho River about twenty years ago with nets, as they destroyed the fish, and asks if this was successful. He directs attention to the statement of Prof. Lu-fong of Tientsin that the Chinese consider the crabs holy and hence the crabs caught are not eaten but burnt, and points out that this is at variance with the statement of Marquard that the crab is a popular item of food in China. In reply to the questions, Y. T. Mao, of the Department of Biology, Yenching University, states that *Eriocheir sinensis* is one of the edible crabs commonly found along the coastal provinces of China and that the Chinese do not consider the crab holy. He adds that according to his observation it is not necessary for the crab to lay its eggs in salt water and that he has not heard that the crabs had to be cleared out from a river at Tientsin, nor has he heard of any river in China inhabited by such a large number of crabs as were stated to occur in the Elbe.

Will the Chinese Mitten Crab Invade British Waters?

THE Ministry of Agriculture and Fisheries has issued a notice (Fisheries Notice, No. 22, June 1934) on this crab, pointing out that it "would in no wise be a welcome addition to the British fauna". During its migrations, particularly upstream, the crab tunnels into river banks and the wash of water in these burrows is liable to cause subsidence and hence serious damage to the banks. Further, the crab is voracious; it clears bait from lines and eats the fish taken thereon, and bites through nets and lines. The note suggests that a careful watch should be kept for this crab, especially on the east coast of Great Britain; its destruction at all possible times might at least assist in restricting the numbers of this unwanted invader.

Science and Social Problems

IN a lecture on "The Man of Science and the Science of Man" delivered at the University of Liverpool on December 7, a copy of which reached us recently, Prof. J. L. Myres discusses the responsibility of science for social disorder. Much of the current confusion of thought in this matter he attributes to the common failure to distinguish discovery from invention, and, more dangerous still, the engineer or inventor from employers or exploiters who require an immediate solution of a particular practical problem in applied science for their own purpose. The man of science has an individual moral responsibility for the full use of his specific powers in investigating Nature and rationalising the world around him, and the growth of personal responsibilities, with the concurrent graver risks of personal abuse, provides some of our most serious social and international problems. One of the problems to which thought has not yet been adequately applied in this way is the problem of leisure, which is one with that of unemployment or disemployment through the growth of rationalisation or mechanisation of industry. For this our system of education, and particularly the high degree of specialisation in the training of students of science, are largely to blame and Prof. Myres enters an eloquent plea for expositors of science who are competent to impart to the general community something of the spirit and methods of science, so as to afford them an adequate general scientific background for the life they lead in this highly technical age.

PROF. MYRES deals also a hard blow at the slovenliness of the scientific worker in his written communications whether for the specialist or a wider public, particularly his neglect to use current linguistic coin, acceptable at its face value of words or sense. These points in a valuable address may easily be overlooked by the scientific worker in his interest in the subsequent discussion of the clash of cultures in modern life and the way in which a science of man could be of service under modern conditions. A field of scientific research is here visualised, the results of which are potentially applicable to a wide range of everyday problems. There is required, too, the capacity to see life as a whole and not as a series of independent units. The latter tendency, no less than excessive specialisation, are major obstacles to the noble conception of citizenship for which Prof. Myres pleads, and which demands the exercise of freedom in speech, in thought and in life.

National Art Gallery and Museum for New Zealand

AT the ceremonial laying of the foundation stone of a National Art Gallery and Dominion Museum for New Zealand, at Wellington, on April 14, Lord Bledisloe, Governor-General of New Zealand, gave

an inspiring address on the proper functions of such an institution. This has just been published in pamphlet form with the title "The Proper Function and Scope of a National Art Gallery and Museum". "A public museum . . . should not be a mausoleum of dead specimens, the resort only of monastic specialists or interested collectors, but a vitalising power-house radiating currents of intellectual energy and calling forth latent genius in all classes of the community". The difficulty is to know how best to do it. Lord Bledisloe suggests many possibilities: popular exhibits, the encouragement of school children, travelling collections to country districts, special exhibits relating to sanitation, hygiene, child-welfare or town-planning, a comprehensive department illustrative of British seafaring life from the earliest times, and so on. He summarises with insight the values of an orderly ethnographic collection—the scientific study of early civilisations, the promotion of a more sympathetic understanding of subject races, the provision of useful equipment to prospective Colonial administrators and pioneers, and the stimulation of trade by suggesting new ideas both to importers and exporters. On the museum side and on the art gallery side he warns curators and administrators over and over again against the danger of accepting gifts too readily, and of accepting gifts with conditions. He sees in the foundation of the new institute a landmark in the definite and vigorous intellectual and spiritual progress of all classes and both races of people in the Dominion.

WHILE in New Zealand Lord Bledisloe was laying emphasis upon the educative aspects of museums, at the Toronto Meeting of the American Association of Museums, on May 31, Prof. John R. Dymond, director of the Royal Ontario Museum of Zoology, sounded a warning note about the danger of too much educational policy (Science Service, Washington, D.C.). Education is one of the important functions of a museum, but it is not the only one, or the primary one. The peculiar work for which museums exist is to collect and preserve the irreplaceable materials needed for the advancement of knowledge. Should too great a proportion of time or energy or income be spent on educational activities, the real work of the museum will suffer. There are other agencies in every State devoted to educational work, but there is nothing to replace the museum if it halts in its labour of making and conserving collections. But the problem is not quite so simple as it looks—there are things that are not worth the labour and expense of collecting and preserving, and who is to draw the line between judicious collecting and aimless, useless amassing? Perhaps the educational aspect is one of the soundest criteria.

The Psychic Thumb Print Controversy

IN Bulletin 22 of the Boston Society for Psychic Research, published in April 1934, is printed the reply to Mr. Thorogood's lengthy report on the alleged psychic thumb prints produced by the American medium 'Margery', which document was issued as vol. 22 of the *Proceedings of the American Society for Psychical Research* and which was reviewed in NATURE of April 14, p. 550. The controversy revolves around the report of the discovery that both the right and left thumb prints of 'Walter' (the medium's control) are in reality identical with those of her dentist now living in Boston. These charges were examined by the officials of the American Society for Psychical Research, who came to the conclusion that they were without foundation, although it was admitted that in the case of one of the thumb prints the resemblance was close. Counter charges of bad faith, falsification of material evidence and sinister motives were made, and it was alleged that certain of the wax prints obtained exhibit clear signs of alteration. In the present *Bulletin* these statements are considered, and further counter charges are made against the officers of the American Society for Psychical Research, including the suggestion that counterfeit waxes have been introduced and dates forged. In a well-balanced review of Mr. Thorogood's book, Dr. Harold Cummins examines the theory that the sets of prints are not identical, but finds himself unable to accept the claim. Moreover, he severely criticises certain photomicrographs printed by Mr. Thorogood inasmuch as in his opinion they are not strictly comparable.

New 24-Cylinder Aero Engine

AN air-cooled 24-cylinder aero engine, the Napier-Dagger, has just completed its 100-hour Air Ministry type test. It has already been flown for more than sixty hours in a Hawker Hart day bomber aeroplane, and took part in this year's R.A.F. display on June 30. The 24 cylinders are arranged in four blocks of six. Two blocks are set above and two below the crankcase, giving the engine the form of a letter H viewed from the front. This arrangement makes for compactness, especially in frontal area, which is about equal to that of a modern water-cooled engine of similar output. Thus the air-cooled engine gains to the extent of the head resistance of the radiators or such devices as are necessary for cooling the liquid in the other. Each pair of upper and lower cylinder blocks has a separate crank-shaft which transmits the power through gearing to the airscrew shaft. The reduction in this gearing allows the very high engine speed of 4,000 revolutions per minute, while the airscrew travels at such lower speeds as its efficiency demands. One of the most interesting features in the engine is the use of hydraulic impulses to operate the valve gear. This removes the need of rocker arms and also gives a quieter engine. The engine is supercharged to develop its maximum power of 705 h.p. at a height of 12,000 ft., and, at a cruising rate of 3,500 revolutions a minute, it yields 630 h.p. These are with standard fuels; much bigger outputs with 'doped' fuel and higher compression ratios are anticipated. A smaller version of this engine has been flying for some time. This has only 16 cylinders arranged in banks of four. It was known originally as the H engine and is now named the Rapier. The bigger engine makes the type fit for use in military aircraft.

State Help for Gliding

REPLYING to a question in the House of Commons on June 27, Sir Philip Sassoon, Under-Secretary of State for Air, stated that the Government has reached the conclusion that some measure of financial assistance to the gliding movement from the Air Votes is justified. This will probably take the form of assistance towards the formation and maintenance of a properly organised central gliding school, which is regarded as essential to the sound development of gliding, coupled with a small capitation grant to approved clubs in respect of each certificate taken out by their members. Details are not yet known, but will be worked out in conjunction with the various interests concerned. The proposal is that a sum of not more than £5,000 annually, for a five-year period in the first instance, shall be granted. Sir Philip expressed the hope that now that official recognition is to be accorded to the national importance of gliding, generous financial support will also be forthcoming from private sources in order to ensure the success of the movement.

Zeppelin *LZ*–129

A NEW Zeppelin airship, *LZ*–129, is now nearing completion in Germany (Science Service, June 6), and if satisfactory will be put into service as a sister ship to the *Graf Zeppelin*, now operating for the sixth season between Europe and Brazil. The east-bound crossing of the new ship is expected to take less than two days, and the return against head winds a little less than three days. The calculated range without refuelling is 8,000 miles. Although only slightly longer than the American *Macon*, at present the largest airship extant, *LZ*–129 will be considerably larger, with a gas capacity of 7,070,000 cubic feet as compared with 6,500,000 of the *Macon*. On her trial flights this summer, she will be inflated with hydrogen gas. It is reported that the use of helium gas is being considered for normal passenger flights. The Diesel engines, totalling 4,400 horse-power, will be in gondolas attached outside the hull, with ladders permitting access to other parts of the ship as in previous Zeppelin designs. German aeronautical engineers have never accepted the recent American procedure of placing the engine compartments inside the 'hull' or skin. The accommodation includes two promenade decks, state-rooms for fifty passengers, running water and baths, and a special smoking room. Besides these appointments are quarters for a crew of 35 and space for a mail and freight load of ten tons.

International Broadcasting Union

THE issue of *World Radio* of June 29 contains an account of the London meeting of the Union Internationale de Radiodiffusion, which was concluded on June 20, and also the report of the Council of the Union. The meeting was attended by seventy-three delegates, including representatives of the broadcasting organisations of twenty European countries, of the two great American chains of stations and of the Cuban broadcasting organisation; and, in addition, delegates from thirteen European State administrations. The general assembly and business meetings were held at the Grosvenor House Hotel, but visits were arranged to such places of interest as the International Trunk Exchange of the G.P.O., to Broadcasting House and to two stations of the B.B.C. The report of the Council of the Union concerns the European wave-length situation, and such subjects as international programmes and their future arrangement, and the legal aspects of authors' rights. The impression of the Council is that, since the introduction of the Lucerne plan, the general situation in regard to broadcasting on the long wave-lengths has been appreciably improved by the partial application of certain recommendations made at Geneva in February. The situation is complicated by the presence in the long-wave band of the stations Luxembourg and Madona, which were not given long wave-lengths by the Lucerne conference. No solution of this difficulty can be found at present, but recommendations were made to the Governments and broadcasting organisations concerned to re-examine the situation arising therefrom with the view of reaching an arrangement satisfactory to all the interested services.

THE report also states that 409 programmes of special interest or high artistic value were offered by members of the Union to their colleague organisations during 1933–34. Certain of these programmes, such as the relays of the bells of Bethlehem and the Byrd Antarctic Expedition, were accepted by members in various continents. The Union has decided to repeat, in some new form yet to be determined, the successful Christmas programme of 1933, wherein several European broadcasters contributed, by means of specially prepared records, seasonable expressions of goodwill from their respective countries. At the sitting of the new Council which terminated the London meetings, Vice-Admiral Sir Charles Carpendale, of the British Broadcasting Corporation, was elected president of the Union for the tenth successive time. The next meetings of the Council of the Union will be held in Switzerland in February 1935, while the next annual general assembly will be in Poland.

Drinking Water and the Drought

DETAILS have been circulated of an emergency organisation which Imperial Chemical Industries, Ltd., Millbank, S.W.1, with the approval of the Ministry of Health, has set up to assist local authorities which may be experiencing difficulties with their supplies of drinking water. In many instances, owing to a shortage of the regular supply, water has to be obtained from other sources, the purity of which may be doubtful and below the usual standard. Such emergency supplies may, however, be rendered quite safe for domestic purposes provided they are first adequately treated and sterilised. Treatment with chlorine in some form is that generally employed, as it is efficient and comparatively simple in application, the four agents generally used being liquid chlorine, 'chloros', chloramine and

ordinary chloride of lime. Imperial Chemical Industries, Ltd., has accordingly posted a staff of experts trained in water sterilisation at its divisional offices in London, Newcastle, Manchester, Oldbury and Bristol, whose services will be at the disposal of any local authority desiring them for advice and assistance, which will be given free. Once the proper dosage of the particular chemical agent selected has been determined, together with the best method of applying the process, the routine application is comparatively simple.

Liverpool and the Atlantic Ferry

A SUMMER meeting of the Institution of Mechanical Engineers in the Liverpool district would not be complete without a paper on ships and their machinery, and during the meeting on June 26–29, Mr. P. Austin, following in the footsteps of the late Mr. A. J. Magennis, contributed a paper on Liverpool and the Atlantic Ferry. Liverpool shipowners have played prominent parts in the long struggle for supremacy on the North Atlantic between such famous lines as the Cunard, White Star, Collins, Inman and others for a century or so. Beginning with the Black Ball line of sailing packets which connected Liverpool and New York in 1816, Mr. Austin traced the development of trans-Atlantic travel down to the present time, mentioning many once famous ships and recalling many great achievements; and in three tables he gave figures of the growth in size, power and speed of typical ships. In concluding his review, Mr. Austin asked, "Is the Liverpool airport to be one of the terminal ports of the Atlantic Ferry of the future?" While not holding that a trans-Atlantic air service is impossible, Mr. Austin has doubts as to its regularity and dependability, due to the vagaries of North Atlantic weather; also there are doubts as to whether such a service ever would be a financial success. As regards the immediate future of the 'Atlantic ferry', the struggle is keener than ever before and the British reply to American, French, German and Italian competition is S.S. *No. 534*.

The National Maritime Museum

IN the House of Commons on June 29, Mr. W. Ormsby-Gore, First Commissioner of Works, moved the second reading of the bill for the setting up of a National Maritime Museum in the buildings recently occupied by the Greenwich Hospital School. The cost of adapting the vacant school buildings is estimated at £29,000 and Sir James Caird has generously offered to defray this sum. Sir James has already given large sums towards the restoration of H.M.SS. *Victory* and *Implacable* and presented the Museum with the Macpherson Collection of Naval Prints. There is nowhere, said Mr. Ormsby-Gore, where one can study the history of our maritime adventure and development, and no attempt has yet been made to illustrate conveniently for the general public the immense field of British maritime endeavour, historical, technical, geographical and commercial, including not only the exploits of the Royal Navy but also of the mercantile marine. A Board of Trustees with the Earl Stanhope as chairman has been appointed and the post of director has been offered to Prof. G. A. R. Callender, of the Royal Naval College, Greenwich, whose enthusiasm and scholarship in all matters appertaining to naval history are well known.

Recent Advances in Physics

THE Manchester and District Local Section of the Institute of Physics holds each year a summer course of lectures, the primary aim of which is to provide physicists in industry with convenient summaries of recent work in various aspects (both pure and applied) of physical research. This year the lectures were held during June in the Physics Department of the University of Manchester. On June 11, Mr. J. D. Bernal (Cambridge) discussed the properties of "Heavy Hydrogen" and indicated some of its possible chemical uses. Prof. E. N. da C. Andrade (University College, London) dealt with the subject of "Viscosity" on June 13. After considering the relation between temperature and viscosity and its representation by a formula, he discussed a theoretical justification for the use of a formula he has developed and finally dealt with some methods of measurement of viscosities. A comprehensive survey of "Units of Matter" was given by Dr. J. M. Nuttall (University of Manchester) on June 25; he discussed the properties of the proton, electron, anti-proton, positive electron, neutron and neutrino, and gave a summary of the experimental evidence supporting the new ideas on atomic structure. On June 27 short communications on "Alloys" were given by Prof. W. L. Bragg, Dr. A. J. Bradley (University of Manchester) and Dr. C. Sykes (Metropolitan-Vickers Electric Co., Ltd.). This is the fourth occasion on which such a course has been held. Last year the meetings were devoted to accounts of the application of physics to particular industries. On this occasion the original plan was adhered to, summaries of recent work in pure science being presented for the convenience of industrial research workers who do not find it easy to follow the many original papers. There has been a gratifying response to the attempt to organise these meetings, and lively discussions have followed most of the papers.

Celtic Earthworks on Salisbury Plain

ARCHÆOLOGISTS are indebted to the Ordnance Survey for further service of no little value in the form of a map of Salisbury Plain, based on the Ordnance Survey map, 1 : 25,000, and showing the Celtic fields and linear earthworks, which is now in course of preparation. The map will be issued in a series of six sections, of which the first, "Old Sarum" (Ordnance Survey, Southampton, 2*s*. 3*d*. net), is now ready. The archæological features of the Ordnance Survey map have been taken as a basis, and to these have been added material from photographs of the plain taken by the Royal Air Force in the course of routine duties and from data recorded by members of the staff of the Survey. Dr. J. F. S. Stone, who has

made a special study of linear earthworks, has also placed his information at the disposal of the Department. No excavations have been undertaken to fill in gaps, but the hope is expressed that archæologists, to whom the map is dedicated, will amplify by their labours the next edition. In a foreword, attention is directed to certain features of the map. A large number of 'barrow circles' have been located by air photography which are here recorded for the first time. Accordingly it has been thought necessary for the sake of consistency to show all barrows from neolithic to Saxon, the long barrows being numbered in accordance with the numbering in the map of Neolithic Wessex. Attention is also directed to the information afforded by the map on the movements of settlement in instances in which the site of cultivation appears to have been stationary and also to that bearing on the purpose of linear earthworks.

Standardisation in Anthropometry

A preliminary statement, to form a basis of discussion, has been issued by the International Committee for Standardization of the Technique of Physical Anthropology and is published in *Man* of June. This Committee was appointed by the International Federation of Eugenics Organizations at its New York meeting on the understanding that, in the event of an international organisation for anthropology being formed, the Standardization Committee would be free to transfer itself to that body. As this condition has now been fulfilled by the institution of an International Congress of Anthropological and Ethnological Sciences, the question of the future of the Committee will be discussed at the forthcoming meetings of the Federation and the Congress. In the meantime, the document now published by the Committee makes certain suggestions for future action, pointing out that while anthropologists have met on several previous occasions to deplore the lack of system and uniformity in anthropometric measurement, no practical result has followed. It is now suggested that a number of regional committees should be formed, and that each of these should discuss the revision of systems of measurement on both living and skeletal material, which after testing, criticism and revision, might be put forward as regional schemes to form the basis of international discussion. As the urgent need for reform is widely recognised, a determined effort to arrive at agreement should be possible, even though revision is likely to prove a lengthy undertaking.

New Oil Well Drilling Record

A new record for deep oil well drilling has been established by the General Petroleum Corporation in the South Belridge Field, San Joaquin Valley, California, by the achievement of a depth of 11,377 ft. (approximately 2·15 miles). This is the first oil well which has been drilled to more than 11,000 ft. and must be considered a remarkable engineering achievement. The well was started in September 1930 and continued until March 1932 when, owing to a 'cut' in the development programme, operations were stopped. Drilling was resumed in August 1933 and the final depth recorded above was reached at the end of May of this year. An equally notable feature of this performance is that a substantial 4¾-in. casing string has been landed successfully at the bottom. There have already been shows of oil and gas in this well, but these have to some extent been smothered by the enforced use of large quantities of very heavy mud held at between 104 and 112 lb. per cubic foot to overcome the high gas pressures met with. The *Oil Weekly* of June 11 gives a detailed account of this well and concludes that improved technique and engineering equipment are the outstanding factors which have made this record possible.

Everglades National Park, U.S.A.

After a certain amount of opposition, Bills for the creation of a National Park in the Everglades of Florida have passed Senate and Congress (Science Service, Washington, D.C.). The park to be created will comprise 1,300,000 acres, and will be unique amongst the larger national parks in lacking mountains. The fauna is tropical, comprising snakes and alligators, several beautiful herons, spoon-bills and the almost extinct 'bone-headed' ibis, and characteristic vegetation. Beyond the coast the park will extend to several of the small islands or 'keys', so that a sample of the rich tropical marine fauna will be available to the visitor. Access to the area will apparently be from the present road, the Tamiami Trail, on the northern boundary of the reserve, but further exploration can be made only on foot or in canoes under the guidance of Seminole Indians. Interest is added to the scheme by the proposal to establish a new Seminole reservation to the north of the Tamiami Trail, in close proximity to the Park itself.

Health of the Navy during 1932

In the "Statistical Report of the Health of the Navy for the Year 1932", recently issued (London: H.M. Stationery Office. 2*s*. 6*d*. net), the Medical Director-General of the Navy, Sir R. St. G. S. Bond, states that in a force of 83,285, the total number of cases of disease and injury was 39,284, equivalent to a ratio of 471·68 per thousand, an increase of 6·12 in comparison with the five years' average, and a decrease of 19·82 in relation to 1931. Only four cases of typhoid fever and eight cases of paratyphoid fever occurred during the year. Fifteen cases of undulant fever were returned, of which twelve were from the Mediterranean Station. Venereal diseases have declined in number, the fresh admissions totalling 4,638 as compared with 4,962 in 1931. Details are given of some of the cases of interest that have occurred, and of research work.

Chimpanzee Twins

Dr. Robert M. Yerkes has described the first authentic recorded case of the appearance of twins in an anthropoid ape family (*Science*, May 11, 1934).

The twins, one male the other female, were born almost a year ago at the Anthropoid Experiment Station of Yale University, at Orange Park, Florida. The parents were chimpanzees, the male about eleven years old and the female about twenty. Although among other primates, such as lemurs, gibbons, baboons and monkeys, twin births, according to Dr. Yerkes, have occasionally been recorded, the higher apes, chimpanzees, orang-outans and gorillas, have not hitherto been known to give birth to more than one young at a time.

Committee on Street Lighting

THE following Departmental Committee has been set up by the Minister of Transport to report on the lighting of streets: Mr. F. C. Cook (deputy chief engineer, Ministry of Transport) (chairman): Mr. J. F. Colquhoun (public lighting engineer, Sheffield); Mr. C. A. Masterman (chief technical officer, Gas Light and Coke Company); Major W. H. Morgan (county engineer, Middlesex); Mr. C. C. Paterson (chairman of the Illumination Research Committee, Department of Scientific and Industrial Research; director of Research Department, General Electric Company); Mr. E. S. Perrin (Ministry of Transport); Major L. Roseveare (borough engineer, Eastbourne); Mr. J. R. Taylor (Ministry of Health); Dr. J. W. T. Walsh (National Physical Laboratory). The secretary of the Committee is Dr. H. F. Gillbe, of the Ministry of Transport, and its terms of reference are: "To examine and report what steps could be taken for securing more efficient and uniform street lighting, with particular reference to the convenience and safety of traffic and with due regard to the requirements of residential and shopping areas, and to make recommendations".

German Association of Men of Science and Physicians

THE German Association of Men of Science and Physicians will hold its ninety-third meeting in Hanover on September 16–20. The invitation to meet in Hanover is now of more than twenty years' standing. It was accepted at the Vienna meeting of 1913 and planned for the next year, 1914. Since then, the Association has held its centenary in Leipzig in 1922, and has travelled south and west and north and east to Innsbruck, Düsseldorf, Hamburg, Königsberg and west again to Wiesbaden and Mainz. Hanover is easily accessible by land and air. This is the first meeting under the new constitution and an impressive proclamation of German science is desired. Public dinners are to be minimised, but exhibitions and excursions are planned. An associate's ticket costs 20 gold marks, application to be made to Geschäftstelle G.D.N.A., Leipzig, C.1, Gustav-Adolfstr. 12. A detailed programme is available showing the general addresses and combined sessions, also the 37 separate sections and some twenty allied associations. The *Zweckverband* provides a brief directory of more than thirty German scientific societies. The exhibition dedicated to "Deutsches Volk—Deutsche Arbeit" is to give a picture of the history of the German race, with emphasis on heredity, genetics and eugenics, and also on chemistry as a domain in which intellectual leadership is fundamental for industry. The local secretaries will be at Hanover, Technische Hochschule, Welfengarten 1. Among the distinguished men who are already announced as likely to be present are Prof. W. Heisenberg, Dr. Eckener and Dr. Sven Hedin.

Announcements

THE fifty-third annual meeting of the Society of Chemical Industry will be held at Cardiff on July 16–20, under the presidency of Dr. J. T. Dunn. The presidential address, entitled "Science and Industry —the Fertility of Ideas", will be delivered on July 17. Other addresses include Prof. H. Freundlich on "Plasticity the Servant of Industry", Sir Harry McGowan (to whom the Messel Memorial Medal will be presented) on "The Uneven Front of Research", and Col. C. H. Bressey on "British Roads Development during the past Fifteen Years".

A RECENT Bulletin (No. 70) published by the Ministry of Agriculture and Fisheries (1*s*.) deals in a thorough way with the keeping and breeding and other activities connected with making the most of "Ducks and Geese".

THE Achema VII Exhibition Guide, a directory of manufacturers of chemical plant and apparatus in Germany, published and issued in connexion with the Achema VII, held at Cologne on May 18–27 (see NATURE, June 2, p. 843) is, we are informed, now available. Copies can be obtained from Dechema, Seelze bei Hannover (1 gold mark, post free).

A VOLUME of "Researches" published from the wards and laboratories of the London Hospital during 1933 has been issued by the Publications Committee, of which Mr. Hugh Cairns is secretary (London: H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1. 7*s*. 6*d*. net). It includes 31 papers dealing with a variety of subjects comprised within the science and art of medicine, and all of them contributing to the advancement of clinical medicine or of medical science.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in pharmaceutics at the Central Technical College, Birmingham—The Chief Education Officer (July 14). An assistant lecturer in zoology at University College, Gower Street, London, W.C.1 (July 18). An assistant keeper (second class) on the higher technical staff of the Industrial Engineering and Manufacturing Department of the Science Museum, South Kensington, London, S.W.7—The Director (July 21). A deputy Government analyst, Ceylon—The Director of Recruitment (Colonial Service), 2, Richmond Terrace, Whitehall, S.W.1 (July 31). A senior lecturer in estate management at the Royal Agricultural College, Cirencester—The Principal. Two demonstrators in the Department of Anatomy, University of Cambridge—The Secretary-General of the Faculties, The Registry, Cambridge.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Structure of the Wood used in Violins

THE many recent investigations on string instruments[1] deal mainly with two problems: the theory of the mechanical and acoustical behaviour of the different parts of the instrument (and its experimental verification), and the analysis of the tones produced by the instruments. The question of the proper choice of material has made scarcely any progress since the fundamental investigations of F. Savart[2]. Since it has been repeatedly stated that age, treatment and varnish change the character of the wood, we investigated the structure of the wood in violins of different origin* with X-rays. Copper $K\,\alpha$ (in a few cases also molybdenum $K\,\alpha$) rays fall (*a*) through the F-hole on to the back of the instrument or (*b*) are reflected from the edges of either top or back.

In all of the instruments investigated, we found that the spruce used for the top shows definite fibre structure, giving almost identical patterns (Fig. 1*a*; for comparison see Fig. 1*b*). But the patterns from the wood used for the back (mostly maple) are different for instruments of different tone quality. Instruments with an even and smooth tone quality, especially for higher pitch (E-string), show an almost complete lack of orientation in the wood used for the back (Fig. 2). The maple used in instruments which have a harsh tone quality in general, weak response and shrill upper register show marked fibre structure (Fig. 2*b*). Since we found that instruments two hundred years old may show such a pattern, it is clear that the ageing of the wood after cutting and working does not change its structure. Whether a special treatment

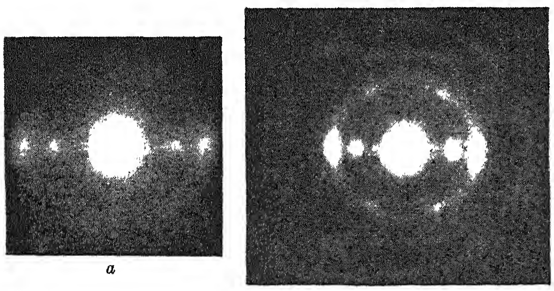

FIG. 1. (*a*) Spruce (top) from "Geneva" Guarnerius; (*b*) ordinary spruce.

of the wood or a special varnish has been used by the Italian makers is so far not certain; we found only in one case a diffraction pattern containing one ring which could not be interpreted as belonging to cellulose.

Investigation of untreated maple as used for violin making has shown that sometimes, although rarely, such maple will show as small an amount of orientation as the wood found in good violins. Occasionally modern violins with properly chosen wood for which Italian varnish and treatment of the wood are not used, show an evenness in tone comparable with the old instruments. All this seems to indicate that the proper selection of the wood is more important for the quality of the instrument than treatment and varnish. We found several instruments with the proper wood, but a poor tone quality. This, of course, can be due to the faulty model of the instrument, but in two cases investigated, a radiographic X-ray study of the interior of the violin revealed a great number of

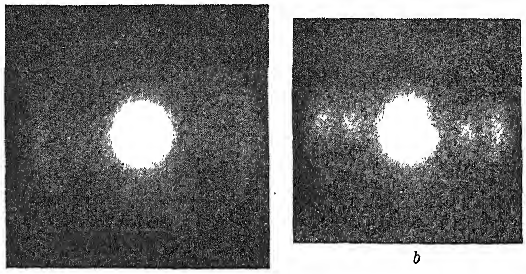

FIG. 2. (*a*) Maple (back), J. Guarnerius; (*b*) maple (back) of modern violin.

crude repairs which necessarily would impair the tone of the instrument. We have found that these radiographic studies are of great value in supplementing the knowledge of the connoisseur and collector.

Our investigation indicates that for a fine instrument only the top should be characterised by different velocity of sound in different directions, whereas the velocity of sound in the back should be the same in all directions so as to produce the best results.

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* We are indebted to Messrs. Lyon and Healey and Wm. Lewis and Son, Chicago, for the possibility of investigating instruments of the following makers: A. and H. Amati, Stradivarius, J. Guarnerius, J. B. Guadagnini, C. Bergonzi, M. Bergonzi, Montagnana, Storioni, Vuillaume, Pique and several modern makers, altogether 24 instruments.

[1] C. V. Raman (summary of all of his important papers); "Handbuch der Physik", vol. 8, pp. 355–424; H. Backhaus, "Handbuch der Experimentalphysik", vol. 17/3, pp. 177–256; 1934. R. B. Abbott, *Phys. Rev.*, August 1933; March 1934.

[2] F. Savart, "Mémoire sur la construction des instruments à cordes et à archet", 1819. The much more important investigations published in *l'Institut*, 8, 55, 69–70, 91, 122, 1840 seem to be entirely forgotten. We found them only quoted in E. Heron-Allen's book on "Violins and Violin Making" and have seen them myself only now. Savart's conclusions should certainly be checked with more modern acoustical methods.

Atomic Theory

MAY I comment briefly on the review of my book in NATURE of June 9, p. 852, by Prof. Fowler, to whom I am grateful for the view that new theories of this nature should always be welcomed. It is to be hoped that serious consideration of the theory will not be prejudiced by what the non-scientific press may have said about it.

(1) *Electrical Conductivity.* It is claimed that it can now be deduced from the R-B atom that the alkalis must be metals, and that this can "probably" be extended to the noble metals. This kind of "pious hope", to use Prof. Fowler's own expression, is quite unnecessary with the A atom, where the metals, non-metals and sub-metals (for example, boron), automatically fall into their appropriate groups.

(2) *Magnetism.* "It is not, however, yet possible

to say quantitatively that such a metal or alloy will be ferromagnetic and such another one not." This is not surprising, since Prof. Fowler admits that the most the *R-B* atom can do is to suggest that the conditions for ferromagnetism "might" be most easily fulfilled among the metals and alloys of the iron group. This is a long way from explaining, as the *A* atom does in its stride, why ferromagnetism is sometimes *absent* in alloys of the iron group (manganese steel), and sometimes *present* in alloys not of the iron group (Heusler alloys).

(3) *Spectroscopy*. Prof. Fowler must have overlooked p. 39 of my book which begins: "*Under suitable conditions*, every element will yield an emission spectrum . . ." On the other hand, Prof. Fowler himself refers to the oxygen atom as "stubborn". It is this spectroscopic property of oxygen, and of other elements, qualitative, but none the less real and important, which is predicted by the *A* atom.

(4) *Chemistry*. "In the chemical field, the qualitative successes of quantum mechanics and the *R-B* atom seem even more striking." Now, if there is one fact which more than any other is fundamental in chemistry and metallurgy, it is the distinction between metals and non-metals, and since the *R-B* atom cannot make this distinction, except for the alkalis, it is doubtful whether chemists and metallurgists share Prof. Fowler's enthusiasm for the striking successes of the *R-B* atom in this field.

(5) *Alpha Scattering*. "When it [an alpha particle] passes near one of the protonic complexes it will also be scattered by Rutherford's law with a factor P^2 when the charge on the complex is Pe." This criticism, if valid, would effectively dispose of the *A* atom, but it is invalid, because the protonic complexes are not rigidly *fixed* as are the atomic nuclei, but move in quantised orbits, and the recoil conditions are totally different. Since the Rutherford law cannot be applied in the way suggested by Prof. Fowler, he is scarcely justified in basing thereon the claim that: "The alternative atom fails outright, self-strangled at birth."

Nevertheless, in regard to the dimensions of quantised orbits of heavy particles, I admit that the calculations are so difficult that I have not been able to make them, but that does not prove that the *A* theory is wrong, nor can it yet be assumed that the *A* theory is incompatible with Coulombian binding forces, particularly since, as Prof. Fowler admits, it is doubtful whether the scattering experiments are able to test this rather fine distinction.

(6) *Isotopes*. This question does not permit at present either of proof or disproof of the *A* theory, but it does open up certain new lines of research which seem worth pursuing.

(7) *Collision Theory*. Finally, Prof. Fowler reproaches me for not touching on this subject. I remedy this omission, since it throws some light on the question at issue, namely, whether the outer regions of atoms are always negatively charged, as for the *R-B* atoms, or whether, as in the case of the *A* atom, they are positively charged for atoms such as oxygen, and negatively charged for atoms such as argon, or positive *cum* negative for a molecule such as ethylene. Here is something which can at once be tested by mixing these gases under pressure, to see whether there is any tendency towards cohesion. This has already been done by Prof. Irvine Masson, who has observed an abnormal cohesion on mixing oxygen and argon, oxygen and ethylene, and argon and ethylene[1]. This curious phenomenon, which is precisely what one would expect on the *A* theory, has never been explained in terms of the *R-B* theory.

Thus, in spite of the criticism which Prof. Fowler has directed against the new theory, I hope that it will receive further serious consideration and discussion.

JOHN TUTIN.

26, Fenchurch Street,
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June 14.

[1] Masson and Dolley, *Roy. Soc. Proc.*, A, **103**, 524; 1923.

I SHOULD have been much disappointed if Dr. Tutin had taken my review of his book 'lying down'. Indeed he has not done so, but he has added little or nothing in his reply to his development of the *A* atom. Paragraphs (1)–(4) merely reiterate what he claims that the *A* atom has done and the *R-B* atom has not. These claims are frankly preposterous.

In my reasoned criticism of Dr. Tutin's book, I took some pains to state at length the present position of the quantum mechanical theory of matter based on the *R-B* atom, and great care to avoid any over-statement of its successes. When it was said that this theory leads to such and such definite results, it was implied that these results were logical consequences of the theory, based on its initial postulates and without any *ad hoc* hypotheses whatever. Chapter and verse can be given for the proofs of all such results. Where I expressed the opinion (a pious hope!) that such and such phenomena were probably explicable in the same way, it was again implied that they were probably thus explicable without additional hypotheses, certainty being merely held up by mathematical complexity, a very different thing from difficulties in or uncertainty of physical principles. In contrast to this, there is not one single statement of a result in the whole of Dr. Tutin's book which can be regarded as there presented as a logical deduction from a definitely stated theory; the scattering laws should perhaps be excepted and to these I return later. I do not assert that his results can never be so presented. I maintain only that none of his results has yet been so presented and that most of them never will be. His candid admission in the last part of section (5) of his reply shows this so clearly that comment is scarcely necessary. It is no use just repeating the claim of what the *A* atom can do, in magnetism, for example. What is required is logical deduction.

I return now to the scattering of α-particles, not because anything need be added to, or withdrawn from, my former criticism, in order to meet Dr. Tutin's reply, but because it is perhaps worth while analysing this reply as a typical example of the vague and unsatisfactory nature of Dr. Tutin's reasoning throughout his book. Briefly, the gist of his objection here is as follows. He has two force centres, *A* and *B*, bound together by certain forces, and a third body *C* collides with them. When *C* goes close to *A*, *A* and *B* are effectively rigidly connected and recoil as a whole. When *C* goes close to *B*, this does *not* happen. Yet the particles are said to obey the laws of quantum mechanics! In any mechanics except the Tutinian, what is sauce for the goose is sauce for the gander, and I cannot withdraw my verdict of self-strangulation, which Dr. Tutin would apparently accept apart from this plea of non-reciprocity.

In the last paragraph of his reply, Dr. Tutin directs attention to some interesting experiments by Prof. Masson on the equilibrium *p-v* isotherms of binary mixtures of oxygen, ethylene and argon. These experiments on the *equilibrium* states of gas mixtures have little or nothing to do with collision theory as usually understood; this, however, is unimportant. Dr. Tutin claims that the evidence they supply for a fairly strong attraction between pairs of molecules of these gases is in favour of his theory and against the *R-B* atom, because with the *R-B* atom all these molecules will be negatively charged on the periphery. He overlooks entirely the fact that for electrically neutral systems (such as these molecules) the residual polarisation effects with which we are here concerned always yield an extra attraction no matter what the unperturbed arrangement of their charges. This is a classical result which prevents discrimination between such theories in any such way.

Here, for the present at any rate, one may well take leave of Dr. Tutin's theory. *If* it ultimately proves of value and supersedes the *R-B* atom, no one will be more surprised than the present reviewer —and no one more delighted. Such success would imply the construction of a logical theory appreciably more successful than current theory in interpreting the properties of matter, and current theory is a lusty infant of whom its parents and guardians, even metallurgical and chemical, are justifiably proud.

R. H. FOWLER.

Spontaneous Emission of Neutrons by Artificially Produced Radioactive Bodies

I. CURIE, F. Joliot and P. Preiswerk[1] observed that after bombarding silicon or phosphorus by neutrons, the artificially produced radioactive nuclei emitted: (1) negative electrons as previously observed by Fermi[2]; (2) γ-rays of high energy ($\sim 5 \times 10^6$ e.v.); (3) positrons (which they tentatively suggest to be due to the creation of 'pairs' by the γ-rays, an explanation which does not seem very probable as they state that the positrons have an upper energy limit of $\sim 1 \times 10^6$ e.v. only); and (4) *neutrons*. They assume that some of the radioactive nuclei are ${}_{13}Al^{28}$ and ${}_{14}Si^{31}$, and that the spontaneously emitted neutrons are due to the transformation processes:

$${}_{13}Al^{28} \rightarrow {}_{13}Al^{27} + {}_{0}n^{1} \text{ and } {}_{14}Si^{31} \rightarrow {}_{14}Si^{30} + {}_{0}n^{1}.$$

If this formal explanation is correct, the neutron must have existed in its parent nucleus in a state of *positive* energy. But this would mean that there exists in a nucleus a potential barrier for neutrons, which would not only contradict current theoretical views about the interaction forces between neutrons and neutrons or protons[3] but would also be in disagreement with Fermi's[2,4] discovery that neutrons easily penetrate into nuclei of all charges and masses.

The spontaneously emitted neutrons must therefore get into a state of positive energy by some primary radioactive process, and then be *immediately* emitted. Assuming the potential energy of a neutron in the field of any nucleus to be everywhere negative, and the potential energy of a proton to show a 'barrier', we have two possibilities for explaining the emission of neutrons:

(i) In the radioactive nucleus *A*, all negative energy states of protons are occupied and there exists *one* proton in a state of positive energy. This proton may either penetrate the barrier of *A* or transform into a neutron, emitting a positive electron. We must assume that the neutron can be created in a state of positive energy. It can then *either* be emitted *or* fall into a state of negative energy, causing an emission of a γ-ray. But it is rather unlikely that an unstable nucleus produced out of a stable nucleus by neutron bombardment (and therefore short of protons) should not have an unoccupied negative energy state for a proton. If *A* has an unoccupied negative energy state, a proton cannot remain an appreciable time in a state of positive energy.

(ii) The radioactive nucleus *A* contains two loosely bound neutrons. One of the neutrons (n_1) transforms into a proton, emitting a negative electron. The proton may be created in an excited state p' and then fall down to a lower state p, whereby it can emit a γ-ray. Alternatively, the transition energy can be handed over to the second neutron (n_2) which will thus be raised to a state of positive energy and will then be emitted. This model seems preferable to (i).

Recent observations of M. Mäder[5] seem to show that samarium emits protons spontaneously. As samarium is known to emit α-rays[6], it may be that the emission of a proton (or alternatively the emission of a γ-ray) follows immediately after the emission of an α-ray. If this is not the case, we must conclude that one isotope of samarium contains a proton in a positive energy state. From (i) we might then expect samarium also to emit positrons, for a nucleus with a proton in a positive energy state certainly has a lower unoccupied state for a neutron, which makes a proton $\rightarrow$ neutron transition energetically possible. The neutrons can then only be emitted if they are created in states of positive energy.

M. GOLDHABER.

Magdalene College,
Cambridge.
June 22.

[1] *C.R.*, **198**, 2089, June 11, 1934.
[2] *Ricerca Scientifica*, V, **1**, 283, 330; 1934. NATURE, **133**, 757, May 19, 1934.
[3] W. Heisenberg, *Z. Phys.*, **77**, 1; 1932. **78**, 156. **80**, 587; 1933. E. Majorana, *Z. Phys.*, **82**, 137; 1933.
[4] NATURE, **133**, 898, June 16, 1934. E. Amaldi, O. D'Agostino, E. Fermi, F. Rasetti, E. Segre, *Ricerca Scientifica*, V, **1**, 452; 1934.
[5] *Z. Phys.*, **88**, 601; 1934.
[6] G. Hevesy and M. Pahl, NATURE, **130**, 846, Dec. 3, 1932.

Hyperfine Structure of the Resonance Lines of Potassium

THE hyperfine structure of the resonance lines (7699 and 7665 A.) of potassium has been investigated by means of absorption in a potassium atomic ray. The lines were obtained in emission from a discharge tube containing neon at a pressure of a few millimetres, and potassium vapour at a pressure of less than one two thousandth of a millimetre; the tube was excited by means of external electrodes, and was of the type used by Jackson in previous investigations on the structures of resonance lines.

Before entering the spectrograph, the resonance light passed through a ray of potassium atoms, the direction of the atomic ray being at right angles to the line of sight. The atoms forming the ray passed through a cool tube the length of which was twenty times greater than the width, so that the component

of the velocity of the atoms in the direction of the line of sight was reduced to one twentieth of the normal atomic velocity. The Doppler width of the absorption lines produced by the atomic ray is therefore only one twentieth of that given by potassium vapour at the same temperature with random distribution of velocities; this is equivalent to absorption by potassium vapour at one four-hundredth of the temperature, that is between 1° and 2° Abs. The spectrograph used for examining the atomic ray absorption contained as high resolving power instrument a Fabry-Perot étalon (this instrument is particularly effective in the infra-red on account of the high reflecting power of silver) with a plate separation of 10 cm., and a resolving power of about six million. In the absorption, each of the resonance lines was found to consist of two very close components; the separation of these components was approximately $0 \cdot 015$ cm.$^{-1}$.

The observed doublet hyperfine structure corresponds to a splitting of the $4\ S_{1/2}$ term of the lighter isotope, 39, of potassium (the heavier isotope is present to the extent of about 5 per cent, which is insufficient to give rise to absorption under the experimental conditions). This indicates a value of the nuclear magnetic moment between $0 \cdot 3/1838$ and $0 \cdot 5/1838$ of a Bohr magneton, according to the quantum number of the nuclear spin (I).

The resonance lines of sodium were also examined by absorption in an atomic ray, an étalon of 4 cm. plate separation being used. Both the lines were found to be close doublets, the separation of the two components being $0 \cdot 06$ cm.$^{-1}$. This is in agreement with the structure of the sodium lines found by Schueler, working with a liquid air cooled, hollow cathode discharge tube.

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H. KUHN.

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June 21.

Negative Nuclear Spins and a Proposed Negative Proton

THE atomic nuclear spin data obtained from the analysis of fine structures in line spectra show that odd atomic weight atoms have nuclear spins. There are two groups of odd atomic weight atoms, namely, those with odd and those with even atomic charges. The nuclei of the first group contain an odd number of protons and the nuclei of the second group an odd number of neutrons. A significant experimental fact is that all the nuclei in the first group have positive nuclear spins, whilst nuclei of the second group can exhibit either positive or negative spin values.

Landé[1] has proposed a theory to account for the nuclear spin properties of the first group by assuming that only the single odd remaining proton, which has both spin and orbital momenta, produces the nuclear spin properties. This theory gives approximately correct values for many nuclear magnetic moments. If the theory is extended to the second group of odd atomic weight nuclei, a difficulty arises because of the negative spins. Schüler[2] has suggested that the remaining nuclear core also has spin properties, and by introducing a new quantum number infers that the neutron has a negative magnetic moment. There are, however, difficulties in the theory.

It seems possible to account for the negative and positive spins of the members of the second group mentioned above by postulating the existence of two types of nuclear neutrons, namely: (*a*) *proton* plus *electron*, (*b*) *negative proton* plus *positron*. Atoms which have a remaining odd neutron of type (*a*) will exhibit positive nuclear spin, and those with a remaining odd neutron of type (*b*) will exhibit negative spin. On this view the numerical values of the positive and negative $g(I)$ factors should be similar, which is indeed found to be the case.

It is assumed that the negative protons only exist in the bound state of neutrons when they are in the nucleus. Since the difference between the two types of neutrons lies in the relative orientations of the mechanical and magnetic moments, it is not likely that disruption experiments will distinguish between them. The confirmation of the existence of the positron suggests, on grounds of symmetry, that a negative proton might be expected to exist*.

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June 7.

* *Note added in proof.*—After my letter was communicated to NATURE, a note by Schüler and Schmidt (*Naturwiss.*, **22**, 418; 1934) was received wherein the existence of two types of neutrons is also suggested. Tamm and Altschuler (*C.R. Acad. Sci. U.R.S.S.*, **1**, 455; 1934) have attempted to explain the difficulty of negative spins by assuming that several neutrons can contribute to the spin properties.

[1] Landé, *Phys. Rev.*, **44**, 1028; 1933.
[2] Schüler, *Z. Phys.*, **88**, 323; 1934.

The Changing British Fish Fauna

INTRODUCTIONS of foreign species, the results of which deserve close scrutiny, are not confined to mammals. Rainbow trout are now a permanent element in our fauna, black bass are established in certain places, and now the case of the pike-perch in East Anglia deserves to be put on record. On March 4, 1934, a *Lucioperca* of $11\frac{3}{4}$ lb. was caught in the River Delph, near Welney, in the Ouse basin, and was brought here for identification. Five species of the genus are known, two in the rivers and lakes of eastern and northern Europe, one in the Black and Caspian Seas, and two (placed by some authors in a separate genus *Stizostedion*) in Canada and the northern U.S.A. Comparison with specimens in the B.M. (Nat. Hist.) revealed that the Welney fish resembles the American species in five characters and the European in four, but in view of the structural importance of the American characters (especially the distance between the pelvic fins) it is reasonably certain that it came from the American species *Lucioperca vitrea*, Mitchill.

It seems that only one successful introduction of pike-perch to Great Britain has been made, and that was the European *L. lucioperca*, of which 24 fish were put in a pond on the Duke of Bedford's estate at Woburn in 1878. The only explanation of how an American species came to be in England, however, is that it was introduced in mistake for black bass. Inquiries have shown that some nine years ago 20 fingerlings hatched from American eggs which were supposed to be black bass, were put into the Ouse at Erith Bridge, and Prof. Gardiner concludes from scale examination that the Welney fish was in its tenth winter, which suggests that it was one of these 'black bass'. Now a pike-perch can easily be mistaken for a gaunt black bass, so it is

quite possible that American pike-perch are living in other waters to which black bass have been introduced. The danger to our indigenous fauna which the presence of such a predator entails need scarcely be mentioned, but the fact that it seems to have changed structurally in the new environment may throw some light on fish evolution if a British race of *L. vitrea* becomes established.

E. B. WORTHINGTON.

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Effect of Yeast Extract on the Growth of Plants

THE communications on the above subject in the columns of NATURE by Prof. Artturi I. Virtanen[1,2] and Synnove V. Hausen of the Biochemical Institute, Helsingfors, and by Prof. V. Subrahmanyan and G. S. Siddappa[3] of the Indian Institute of Science, Bangalore, are intensely interesting in that they confirm our earlier work on the effect of live and autoclaved yeast and yeast extracts on the growth of plants.

The authors are apparently unaware of our work and so we wish to invite attention to it and to state that it was published in the year 1927[4] as a Memoir of the Imperial Department of Agriculture in India, under the title "The Effect of Manuring on the Vegetative and Reproductive Capacity of the Seed". In this contribution, which deals with the effect of mineral fertilisers and organic manures on the quality of grain as seed and as food, there is a section devoted to the rôle of organic matter in plant nutrition. Here, several experiments on the effect of yeast on different crop plants in sand cultures, soil in pot cultures, and in small plots were reported.

The crops studied were *Eleusine coracana*, *Pennisetum typhoideum*, *Panicum miliaceum*, *Andropogon Sorghum*, *Lycopersicum esculentum* and *Triticum vulgare*. In every case, minute quantities of yeast, either alive or autoclaved, contributed remarkably to growth, flowering and reproduction. It has also been shown that indications were obtained that yeasted grain possessed better nutritive value than unyeasted grain when fed to albino rats. Evidence was given and arguments were advanced to show the possibility of absorption of the growth-promoting factors of the yeast by the plants through their roots, and of the conveyance of these to animals. We also pointed out in the same publication that in the presence of a good supply of organic matter or on soils rich with silt brought down by rivers flowing through forest areas, this effect might not be so marked or might entirely disappear.

One of us (B. V. N.) in recent publications[5,6] discussing the work in progress in our laboratories, directed attention to the hitherto unsuspected rôle of micro-organisms in plant nutrition to which Prof. Virtanen refers in his second letter.

B. VISWA NATH.
M. SURYANARAYANA.

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India.
May 26.

[1] NATURE, **132**, 408, Sept. 9, 1933.
[2] NATURE, **133**, 383, March 10, 1934.
[3] NATURE, **132**, 713, Nov. 4, 1933.
[4] *Mem. Dept. Agri.*, India, Chemical Series, **9**, No. 4; 1927.
[5] "Some Aspects of Plant Nutrition", *Soc. Biol. Chemists*, India; 1932.
[6] *Soc. Biol. Chem.*, India, Symposium, July 1932, p. 12.

Science and Intellectual Liberty

As a German professor, living abroad and without any official connexion with the National-Socialist Government or Party, I would appreciate the publication of some remarks on the attitude of the German Government towards science. On this topic an article was published in NATURE of May 12 under the title "Science and Intellectual Liberty" and a letter by Prof. J. B. S. Haldane appeared in the same issue. Other articles and letters have been published in NATURE, in one of which (June 17, 1933) it was said that "intellectual companionship" with Germany has been made "difficult".

In NATURE of May 12, 1934, I found the phrase "the revocation of academic freedom in Germany will no more be forgotten than the revocation of the Edict of Nantes". Prof. J. B. S. Haldane cites a sentence from one of the prominent National-Socialists acting as rector of the University of Frankfort; this sentence he designates as "not an isolated example of the attack on objectivity, on, in plain English, truth, which appears to be taking place in modern Germany".

I am sure that every reader of NATURE will realise the very grave situation indicated by these few quotations. For centuries, men of science in Great Britain and in Germany have collaborated, both of them in the first rank of the human fight for truth and progress. Now one of these two groups of scientific men seems to be in danger of losing its credit in the eyes of the other through permitting the suppression of objective truth by the present leaders of its own universities.

The rector of the University of Frankfort said that the task of the German universities *to-day* is not to cultivate objective science, but to form the will and character of their students, This is considered by Prof. Haldane as one of the German attacks on objectivity and truth. This and the elimination of a considerable part of the staff of German universities seems to indicate that academic freedom in Germany actually is partly suspended and regarded as less important than national education of the future leaders of the people.

Knowing personally many British men of science, and having been a guest of some of your universities and institutions, I realise that it may be exceedingly difficult to understand in Great Britain the present situation of science in my country.

It would be easier to understand the present events in German universities if readers of NATURE for a moment could imagine a situation in the British Empire comparable to the situation of Germany since the War.

A great people like the British or German nation cannot live without full independence or sovereignty, that is, freedom from foreign interference. If you are able to realise—I repeat, only for a moment—a situation of lost independence of your country, you will also realise the necessity of concentrating every mental force, especially of the cultivated classes, on the one most important vital task, namely, to regain the national independence, to obtain deliverance from the humiliating conditions of enforced treaties.

I am sure that no one in England would complain in a national disaster like ours, if every institution of the country had to postpone everything, including scientific research (objective science), in order to strengthen the mental forces of the people, especially of its future leaders.

I have the impression, and I suppose everybody has, that Germany, since the beginning of its new regime, has made some steps nearer to independence, nearer in any event than Herr Stresemann's Germany ever was. I am sure that my country will reinstate the full academic freedom of its universities and science, as soon as political sovereignty in our own country is assured.

R. WOLTERECK.

College of Agriculture,
Ankara.
May 25.

IT may well be that Prof. Woltereck's restrained and courteous letter will produce upon his colleagues in Great Britain a more painful sense of alienation than the disturbing utterances of those who now control German academic life. We English do not need to be reminded that political excitement often betrays wise and good men into strange company. We are the last people in the world to deny that, in times of panic or excitement, we have said and done things which in retrospect are recognised by us to be wrong and humiliating. But what seems to men of science most deplorable is the elevation of national passion into a principle, the acceptance of a policy which teaches that to attempt to find and hold truth is but a secondary and subordinate activity of the human mind to be postponed or slighted for *any* reason whatever.—Editor of NATURE.

Inheritance of Habits

DR. S. MAULIK[1] has well pointed out the necessity for distinguishing between experiments, like maze threading, in which the nervous system of the animal is primarily concerned, and other experiments in which a foreign substance or a new food material is introduced into the organism—when we attempt to decide whether the new experiences "produce any physical change in the organism".

In regard to the second group, some information can be obtained from a study of the immunity reaction. In the report of the Medical Research Council "On the Chemistry of the Antigens and Antibodies"[2], Dr. L. R. Marrack describes certain experiments by Landsteiner and others, in which an artificially prepared substance—atoxyl azo protein—when injected into the blood, confers on the serum of the animal so treated a capacity to precipitate any other protein, if it is coupled with the diazotised atoxyl.

A physical change is thus brought about in the organism by the introduction of an artificially prepared protein antigen, of which neither the animal nor its ancestors can have had any previous experience.

It is also significant that the organism modifies the molecular composition of the foreign antigen before assimilating it, somewhat as it breaks up, and resynthesises, ordinary food material, though after the incorporation of the foreign protein the constitution of the organism itself also becomes altered.

The immunity so acquired is, however, not transmitted to offspring, at any rate in the human subject, because experience shows that acquired immunity against subsequent attack by the same disease organisms, for example, measles, is not hereditarily transmitted in man.

Prof. MacBride's feeding experiments were carried out on the Ceylon stick insect[3].

It is possible, as I have elsewhere[4] suggested, that human germ cells may be more isolated, that is, more fully protected against influences from the internal environment, than the germ cells of insects, or some other animals. Hence it is not wise to argue directly from one case to the other without further experimental evidence.

C. J. BOND.

Fernshaw,
Springfield Road,
Leicester.
May 30.

[1] NATURE, 133, 760, May 19, 1934.
[2] M.R.C. Special Report Series 194, Chap. iii.
[3] NATURE, 133, 598, April 21, 1934.
[4] Withering Lecture II, University of Birmingham, 1932, "On the Making of Use Acquirements, etc."

PROF. MACBRIDE[1] and Mr. Maulik[2] have raised in the columns of NATURE the important question of the inheritance of acquired habits. Mr. Maulik, if I understand him correctly, states that the offspring of mice trained to run through a maze acquire the same habit more easily than their parents. A reference to the journal in which this remarkable result is published was not given. Mr. Maulik regards it as necessary, before conclusions are drawn, to obtain information as to the nature of the physical change produced by habit in the organism and its reproductive cells. While such information is desirable, it is surely a biological fact that some habits are inherited, even if we do not know the nature of the process of their inheritance. Thus the statistical laws of inheritance of human stature are known, though we have no idea, for example, how many genes are concerned in the process.

Such an excessive demand can only obscure the important issues raised by Miss Sladden's[3] demonstration of the transference of an induced habit (namely, that of feeding on ivy) from parent to offspring in *Carausius morosus*. At least three possibilities suggest themselves. The young insects on hatching may be so saturated with bitter substances from the ivy eaten by their mothers that ivy is less repugnant to them than to insects not so saturated. They may be affected by a *Dauermodifikation* inherited from the mother only and disappearing in a few generations, such as those described by Jollos. Or they may have acquired a character transmissible by both parents, as are most interspecific differences, or such inter-varietal habit differences as that between broodiness and non-broodiness in poultry, or wildness and tameness in mice.

Only in the latter case would the transference of an acquired habit have the relevance for the problem of species formation which Prof. MacBride claims for it. Nevertheless, it should be perfectly possible in suitable cases to test such claims without the very complete knowledge which Mr. Maulik demands.

J. B. S. HALDANE.

John Innes Horticultural Institution,
Merton, S.W.19.
June 8.

[1] NATURE, 133, 598, April 21, 1934.
[2] NATURE, 133, 760, May 19, 1934.
[3] *Proc. Roy. Soc.*, B, 114, 441; 1934.

Collecting Spilled Mercury

On four occasions lately in the presence of a number of skilled experimentalists I have asked the question—How would you pick up from a floor, with a smooth cork carpet covering, a quantity of mercury which had been dropped and broken up into innumerable globules ? I added on each occasion that I thought it likely that any laboratory boy would know but that no professor would. Not once have I received an adequate answer. I have only asked one laboratory attendant, but he was no wiser than his professor. I specify the nature of the floor covering because a Turkey carpet or floor boards with intervening spaces and nail holes are not suitable. The smooth cork carpet is the best floor covering for laboratories other than metallurgical and for lecture tables, and is in common use for these purposes. The question, therefore, touches most of us. Well, the answer is, sprinkle lightly the area which the globules have reached with drops of water from a wash bottle. Then with a squeegee or the straight edge of a piece of strawboard sweep the wetted globules of mercury together. If dry the process is hopeless, they continue to run away and are essentially elusive, but once wet they are tamed, they have the brake on and will not run, and however small they may be they seem to love one another and all cling together in a mass. Then with the same tool or a smaller one sweep them into a small dust-pan made of thin celluloid or even card. The floor is then cleared of all the mercury. Do it.

C. V. BOYS.

Increase of the Percentage of Diplogen in Water during very slow Evaporation

It is known that one of the methods of separating heavy water consists in the fractional distillation of ordinary water. I find that relatively strong enrichment of diplogen occurs during the slow evaporation of water. About three years ago a bottle containing 25 litres of distilled water was prepared for an experiment. The bottle was not used, and the water slowly evaporated leaving about 600 c.c. residue. The measurements showed that this water had a density of 1·0016 (4° C.). For comparison, I have evaporated by boiling a certain quantity of water to 1/60 of its initial volume. The residue had, however, a density of 1·0001. It is evident, therefore, that the action of slow evaporation is more efficacious than the action of boiling.

Extrapolating the equation given by Luten[1] for smaller ratios of D_2O/H_2O, it is possible to calculate that the density, 1·0016, corresponds to a concentration of 1·65 per cent of D_2O.

These observations suggest where to search on the earth for sources of water of greater density. Up to the present, practically no difference has been found in the density between samples of water taken from different points on the earth[2]. I think it probable that heavy water will be found in mountain caves rather than in the large surfaces of seas, where the evaporation is very intense.

T. TUCHOLSKI.

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[1] D. B. Luten, *J. Phys. Rev.*, **45**, 162; 1934.
[2] H. A. McKay, NATURE, **133**, 611, April 21, 1934. E. W. Washburn, E. R. Smith, *Science Abstracts* (S.A.), **37**, 434; 1934. E. S. Griflan, Jr., *J. Amer. Chem. Soc.*, **56**, 406; 1934.

Chromosome Numbers in Menispermaceæ

In a recent communication to NATURE[1], entitled, "Origin of the Angiosperms", Dr. Anderson puts forward the interesting suggestion of the possible origin of modern flowering plants through the Magnoliales from wide crosses between different groups of Gymnosperms showing 12 and 7 as the base number of their chromosomes, such as the modern Ginkgoales, Cycadales and Coniferales show on one hand, and the Gnetales on the other. The various genera of the Magnoliales show 19 as the base number of their chromosomes, which is rather unusual among other families of flowering plants. We have in this laboratory been working for a considerable time on the cytology of the family Menispermaceæ (results not yet published), a close ally of the Magnoliaceæ, and have found the haploid number of chromosomes in *Tinospora cordifolia*, Miers, to be 12, and in *Cocculus villosus*, DC., 19 (12 + 7). Dr. Lindsay[2], in *Menispermum canadense*, Linn., has found the haploid number of chromosomes to be 26 = 19 + 7 = 12 + 7 + 7. It may be asked whether there is any significance in these chromosome numbers in relation to Dr. Anderson's hypothesis. The difference of seven chromosomes between each of the three plants and 12 chromosomes in the species with the lowest number are certainly suggestive facts.

A. C. JOSHI.

Benares Hindu University,
India, May 24.

[1] Anderson, E., NATURE, **133**, 462, March 24, 1934.
[2] Lindsay, R. H., "The Chromosomes of some Diœcious Angiosperms", *Amer. J. Bot.*, **17**, 152; 1930.

The "Johannes Schmidt" Ridge in the Indian Ocean

In his second report on "The John Murray Expedition to the Arabian Sea" (NATURE, May 5, p. 669), Lieut.-Col. Seymour Sewell announces that the echo soundings made from H.E.M.S. *Mabahiss* prove the existence of a vast submarine ridge running diagonally across the north Indian Ocean from the south-east to the north-west and connecting the Chagos Archipelago with Socotra and the Gulf of Aden. May I suggest that the name of Denmark's great oceanographer, the late Dr. Johannes Schmidt, whose discovery of this submarine formation Col. Sewell graciously acknowledges, shall be given to it ?

HANS PETTERSSON.

Göteborgs Högskola.
May 22.

Density of Dead Sea Water

Sir Robert Robertson has recorded in NATURE the results of some determinations of the density of water from the Dead Sea[1]. We had also determined independently the density of two samples from different places by (*a*) the use of a 25 c.c. pyknometer, and (*b*) a differential method employing two sinkers of nearly the same dimensions. The uncertainty in either method is about one in 10^5. In none of the six determinations made could we detect any significant difference between water from the Dead Sea and redistilled water from the laboratory.

R. J. CLARK.
F. L. WARREN.

Egyptian University,
Cairo, June 5.

[1] NATURE, **133**, 611, April 21, 1934.

Research Items

Palæolithic Affinities in Palestine. Miss Dorothy Garrod publishes in *Antiquity* for June a survey of the results obtained by her cave explorations on Mt. Carmel in Palestine, bringing them into relation with discoveries of palæolithic age in other parts of Palestine, and offering tentative suggestions for a correlation of Palestinian palæolithic with that found elsewhere. As only certain points are noted here, it must suffice to say that the Carmel cave series covers from Natufian (Mesolithic) to Tayacian, the recently recognised rough flake industry, dated as to its phase II here represented at the beginning of the Riss-Würm interglacial. For details of the sequence and their distribution in the caves, reference must be made to the original paper. The outstanding feature of the Lower Natufian is the artistic skill of the people shown in bone and stone carving. M. Neuville also has found recently a fine specimen in a cave near Bethlehem. Four stages of the Aurignacian were found, of which the Upper is not comparable with European Aurignacian, but probably with Magdalenian. The next Aurignacian phase (Wad layer *D*) resembles closely, not African, as might be expected, but European Middle Aurignacian, hitherto thought to be a local development from Lower Aurignacian, as Europe was then close to Africa. The earliest Aurignacian (Wad layer *F*) includes a small group of leaf-shaped points which are not known in Europe, but afford a definite link with Africa, where they occur in the Aterian found by Miss Caton-Thompson at the base of the Upper Palæolithic at Kharga. The Aurignacian fauna indicates a change from wooded to open country, whereas the fauna of the Lower Mousterian (Tabun *C*) points to warm swampy conditions with heavy rainfall (rhinoceros, hippopotamus, crocodile). Here was found the nearly complete Neanderthal skeleton, dating from the later Riss-Würm. For the earlier palæolithic stages not represented in the caves, evidence is afforded by Sir Flinders Petrie's recent Acheulean finds at Gaza, in finds by Neuville, south of Bethlehem, and the Chellean and Acheulean tools found by Breuil and Neuville in Jerusalem. Roughly, Tayacian and Acheulean coincide in date with Europe in the Riss-Würm, and climatic conditions suggest correlations with pluvial conditions in East Africa.

Tribal Migrations East of the Mississippi. Mr. David I. Bushnell, Jr., has prepared a series of maps (*Smithsonian Misc. Collect.*, **89**, No. 12) to show the country traversed or occupied by the tribes east of the Mississippi before they first became known to Europeans, when their distribution was that shown in J. W. Powell's linguistic map, as corrected by more recent research. Mr. Bushnell's evidence is derived from the investigation of ancient sites, as well as a comparison of language, customs, etc. The earliest movements were probably Uchean and Siouan, and the ancestors of the Natchez, Timucua and Calusa may belong to the same early period. These last two are the proto-Muskhogean. The Siouan advanced into the valley of the Ohio and may have been responsible for the erection of the great earthworks, while the massive mounds of Cahokia and others as far as Georgia may have been erected by proto-Muskhogean. The Iroquoian and Muskhogean, with the Caddoan to the west of them, were still on the right bank of the river. In the next period the proto-Muskhogean reached Florida, the States of Tennessee and Kentucky were crossed and recrossed by Siouan, Uchean, Iroquoian and Muskhogean stocks; while Algonquian, possibly now and certainly later, frequented the same region. In the third period, fortified camp and village sites have been traced northward from central Tennessee and Kentucky across the Ohio in the eastern counties of Indiana to the north of the State and thence eastward to the traditional home of the Iroquois. These sites were constructed and occupied by Iroquoian tribes. This northern thrust separated peoples of the Algonquian and Siouan groups, who had been in contact in southern Ohio. The groups of tribes continued to move until by the sixteenth century they were located as indicated on Mr. Bushnell's last map, with the Siouan scattered far from their homes in Ohio and the Muskhogean occupying the greater part of the south-east.

Some New Deep Sea Fishes. Mr. Albert Eide Parr in his paper "Deep Sea Berycomorphi and Percomorphi from the Waters around the Bahama and Bermuda Islands. Scientific Results of the Third Oceanographic Expedition of the *Pawnee* 1927" (*Bull. Bingham Ocean. Coll.*, **3**, Dec. 1933) presents a sixth report dealing with the deep sea fishes collected during the *Pawnee* expedition under the sponsorship and direction of Harry Payne Bingham. Two new families, six new genera and eleven new species are introduced. Several hitherto little-known species are also described. The new families Gibberichthyidæ and Korsogasteridæ (both in the Berycomorphi) each include a new genus of one species, *Gibberichthys pumilus* and *Korsogaster nanus*: the first seems to occupy a peculiarly isolated position and the introduction of a new family is apparently fully warranted. Unfortunately, only one specimen was available, as is also the case with *Korsogaster nanus*, which shows a fairly close resemblance to *Leiogaster*, differing in the absence of scales and the development of dermal spines in their place, and in several other features. A female specimen of *Parabrotula dentiens*, Zugmayer, gave birth to living young immediately after capture. One of these young, 6·5 mm. long (the mother being 41 mm. long, without caudal fin), is illustrated, showing a somewhat tadpole-shaped body with attachment cords still remaining, a simple continuous fin round the tail and very small pectorals.

Phases of the Red-winged Locust. In the *Bulletin of Entomological Research* of March 1934 (**25**, Pt. I), Messrs. A. P. G. Michelmore and W. Allan contribute a paper on this subject. The prevalence of a cycle of activity of the red-winged locust (*Nomadacris septemfasciata*) in north-eastern Rhodesia began with the appearance of swarms in an area of marsh country. This event gave opportunity for studying the *gregaria* and *transiens* phases of that insect, but no undoubted examples of the phase *solitaria* were met with. Cage experiments, made with crowded hoppers, suggest that activity is the factor in crowding which influences the production of *gregaria* characters, as maintained by Faure. The prevalent green colouring of *transiens* (*dissocians*) hoppers appears to be associated with high humidity and the

presence of green food. Other colour types of the *transiens* phase are conditioned by those of the environment. An aberrant pallid type of hopper is described and its origin appears to be due to the effects of parasitism by nematodes and possibly also by dipterous larvæ. Factors influencing adult coloration are discussed. Adults crowded in cages, and derived from hoppers reared similarly under crowded conditions, did not undergo the same colour changes observed in the field. The red swarming coloration failed to develop in caged individuals and was replaced by a brown pigment which assumed a similar distribution over the insect. Biometrical data obtained from a variety of types are tabulated and discussed. It is shown that certain characters, especially the relative sizes of the sexes, the degree of development of the femur in relation to the wing, and the relative length and degree of constriction of the pronotum differ greatly in *gregaria* and *transiens* types and afford useful distinguishing characters.

Australian Sponges. The study of the collection of sponges brought home by the Great Barrier Reef Expedition has afforded M. Burton (Sci. Reports Great Barrier Reef Exped., 4, No. 14, 1934) the opportunity to review our knowledge of the sponges of the Australian region, especially with regard to their nomenclature. 107 species are recorded, 17 of which are new, and five new genera are created. The author points out that species on the Barrier Reef are found also in the West Indies, the Azores and the Mediterranean and that the sponge faunas of the Indian Ocean and the Malay area include many species showing the same distribution. "So far as can be seen at present, the line of their distribution follows through from the Malay area and Indian Ocean, round the most southerly point of the African continent, up its west coast to the Azores and thence into the West Indies on the one hand and the Mediterranean on the other. Moreover, these same species do not seem to occur outside this area. It is possible that a detailed study of this problem may shed interesting light on the migration of species and the factors limiting distribution."

Pollen Constancy of Bees. A useful study entitled "Further Observations on the Pollen Constancy of Bees" by W. H. Brittain and Dorothy E. Newton has appeared (*Canadian J. Res.*, 10, No. 3, pp. 255–263, March 1934). Several authorities have supposed that hive bees do not gather honey from more than one species of plant at the same time, but the present paper shows that this is not always the case. Whilst bees of the species *Apis mellifica* obtained pollen from one species in 56 per cent of their loads, the remaining loads were mixed, and in a few cases, pollen from four different species was found. Bees belonging to the genera *Andrena* and *Halictus* have a lower degree of constancy than the hive bee. It appears that insects which occur most commonly on apple blossoms have also a wide range of other pollen hosts.

Yield of Rubber from Vegetatively Propagated Clones. Very rapidly the scientific study of vegetative propagation in the tropics is enabling variable material grown from seed to be replaced in the plantations by more uniform plants multiplied by vegetative propagation from selected parents. In the case of rubber, both budded and grafted material has been successfully propagated, and it is significant that the *Journal of the Rubber Research Institute of Malaya* of March 1934 contains papers by Mann, Billington and Kaimal and by Rhodes and Mann, upon the yield of latex from such vegetatively propagated clones. The point seems already established that, as might be expected, the trees of a clone, all multiplied vegetatively from one parent plant, are more uniform in growth habit and show a good correlation between growth in girth and yield of latex. It is found, however, in tapping the new plantations, as yet of very young trees, that the yield of the parent may not apparently be a reliable criterion of its value as a founder of a clone. From a group of 19 trees selected from 500, only 4 have given buddings which appear to possess the necessary high-yielding characteristics. This means that progress may be slow, but none the less it should be sure, and the figures supplied by Rhodes and Mann certainly suggest that there is great uniformity in behaviour in the trees of a clone. As the selected clones are studied, naturally various types are eliminated for reasons connected possibly with other characteristics than yield. This appears to have led to some uncertainty amongst practical growers as to the future of the new methods, but an estimate by C. E. T. Mann of yield under commercial conditions from clone plantations shows that the outlook for the new practice is definitely favourable.

The Genus *Meconopsis*. The *Gardeners' Chronicle* of June 9 contains a useful review of the development of our knowledge of the genus *Meconopsis*, since it was established upon the single species *M. cambrica* in 1814. The increasing popularity of various *Meconopsis* species for garden use has led to the publication of many systems of classification. Sir David Prain kept pace with the rapidly increasing number of species from 1896 until 1915, and recent plant collecting expeditions have yielded still more material. Mr. George Taylor has published a revision ("An Account of the Genus *Meconopsis*", 130 pp. Flora and Sylva, Ltd., London, 20*s*.), reviewed in NATURE of May 26, p. 777. The group is now divided into four sub-sections: Cambricæ, Eucathcartia, Discogyne and Polychætia. Habit, floral colour and pubescence are the distinguishing characters which separate the sub-groups. Polychætia are further subdivided into Eupolychætia and Cumminsia. The latter group contains the most common garden species, and is arranged in six series: Simplicifoliæ, Grandes, Primulinæ, Delavayanæ, Aculeatæ and Bellæ.

Rhætic Mammals. Some new teeth of the earliest known mammals have been discovered and described by Miss Erika von Huene, who has lately made an exhaustive study of the fossils in the Rhætic bone-beds of Würtemberg (*Jahreshefte Vereins vaterl. Naturkunde in Württ.*, 65–128; 1933). One tooth named *Mucrotherium* seems to belong to a Multituberculate like *Tritylodon*; *Uniserium* is of uncertain relationships; and other unnamed teeth may represent Plagiaulacids and Pantotheria. With these in the Rhætic bone-beds of both Würtemberg and Somerset, there are very small tricuspid teeth, named *Tricuspes*, which probably belong to mammal-like reptiles.

The Noto (Japan) Earthquake of 1933. The Noto peninsula branches off from the north-west side of the Main Island of Japan. A strong earthquake that

occurred in the middle of the peninsula on September 21, 1933, is described by Mr. T. Suzuki (*Earthq. Res. Inst. Bull.*, 12, 44–51; 1934). Though of merely semi-destructive strength—three persons were killed and a number of houses were partially destroyed—fissures occurred in the epicentral area and soft ground subsided locally. The epicentre lay in lat. 37° 4′ N., long. 136° 57′ E. During the following November, the central district was re-levelled (*Bull.*, 12, 52; 1934). Comparing the new heights of the bench-marks with those obtained in August and September 1928, it was seen that the whole area had risen slightly, in one part by 29·0 mm. or 1·14 in.

Alpine Landslips. M. F. Montandon has done most useful work in compiling a catalogue of great Alpine landslips during the Christian era (*Matér. pour l'Étude des Calam.*, No. 32, 271–340; 1933). The tests for a great landslip are that its volume should exceed three million cubic metres, that it should destroy completely a town or several hamlets or villages, or should block up an important valley. The total number of such landslips is 160, the numbers for the last five centuries being 21, 14, 16, 25 and 43. The number of lives lost since 1501 is nearly 4,000, the numbers in 16 landslips ranging from 30 to about 1,200. The largest six landslips, each containing more than thirty million cubic metres, all occurred in secondary or tertiary formations. The number of places destroyed by landslips or the resulting floods amounts to 9 towns, 48 villages and 73 hamlets. M. Montandon gives three maps, of the western, central and eastern Alps, on which the sites of the landslips are marked. These sites are grouped in three well-defined zones, the north-west end of the Alpine arc with Mont Blanc as centre, the basins of the Reuss, Linth, Tessin and Adda with the St. Gothard as centre, and the massifs of the Dolomites and the Hohe Tauern. On the other hand, landslips are rare in two zones, the upper basins of the Durance and Po, and the districts of the Inn and Adige; and they are entirely absent from an extensive area in Austria and Carinthia. More than a quarter of the whole number occurred in seven bands, which altogether form a very small fraction of the Alpine region.

A Theory of the Viscosity of Liquids. In two recent papers (*Phil. Mag.*, 7, 17, 497 and 698) Prof. E. N. da C. Andrade develops a theory of the viscosity of liquids which, unlike earlier attempts, leads to remarkable agreement between calculated and observed values. The liquid state is assumed to resemble the solid much more than the gaseous: the molecules vibrate about equilibrium positions which shift slowly whereas in the solid they are fixed. The frequency is assumed to be the same in both the solid and liquid state, and support is adduced for this view. In a velocity gradient the transfer of momentum between adjacent layers takes place, not as in gases by diffusion of molecules, but by momentary combination of molecules at extreme libration. On these assumptions the viscosity coefficient may be expressed in terms of the atomic weight, the melting point and the atomic volume at the melting point, without an arbitrary constant. The values thus calculated agree very well with experimental data over an astonishingly wide range. The second part of the paper deals with the variation of viscosity with temperature and pressure. The transfer of momentum postulated above occurs only in favourable conditions of energy of the molecules in the intermolecular field, so that the probability of transfer follows the Boltzmann temperature law. On this basis an exponential formula with only two arbitrary constants is deduced, which agrees closely with experimental data for all liquids except water and some tertiary alcohols, anomalous also in other respects. By assuming that the fundamental frequency varies with pressure in accordance with Einstein's compressibility equation, a formula for the variation of viscosity with pressure is obtained which contains no fresh arbitrary constant and agrees with experiment up to about 3,000 atmospheres.

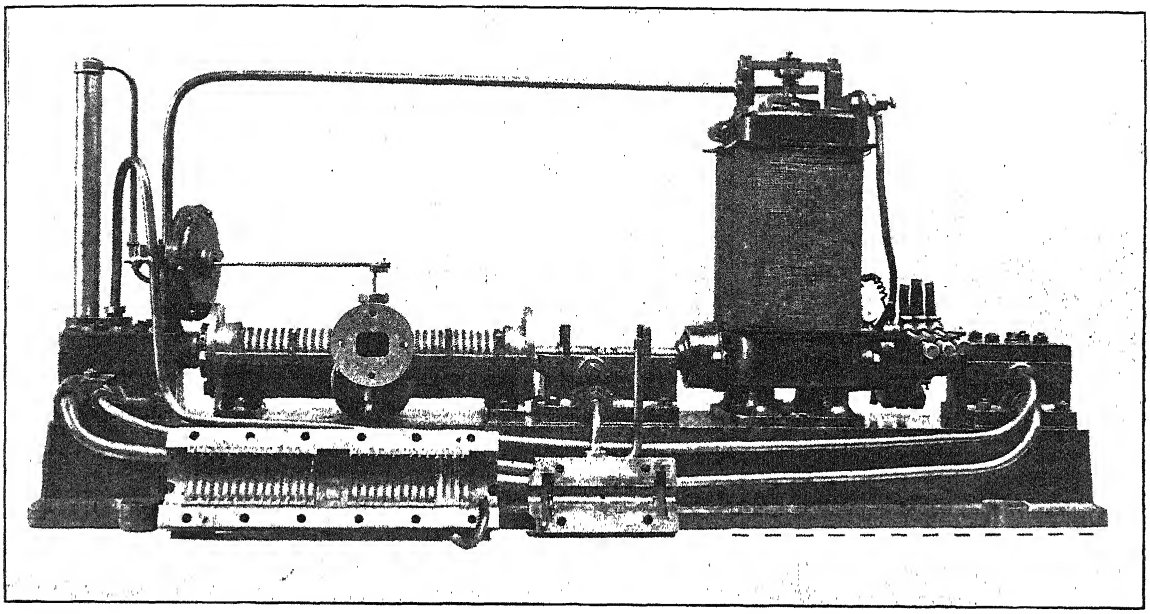
Experiments with Heavy Hydrogen. A. Farkas, L. Farkas and P. Harteck (*Proc. Roy. Soc.*, A, April) have carried out a number of experiments on the equilibrium between the molecular species present in a hydrogen isotope mixture and on the *ortho-para* conversion of the heavy hydrogen molecule. In order to analyse the gas mixtures they use the heat loss from a wire at two different temperatures, the wire being surrounded by the gas sample under low pressure. The variation of specific heat with temperature is at low temperature very different for hydrogen and for diplogen. In contact with a nickel wire at 600°, the molecules H_2, D_2 and HD rapidly come to equilibrium, and thermal measurements made before and after contact with hot nickel enable the authors to determine the HD content of a sample. It was found that the two isotopes tend to separate by diffusion when the mixture is pumped through a fine nozzle; there is, however, no preferential absorption on charcoal. When a mixture diffuses through a palladium tube, there is a preferential transmission of H^1 at lower temperatures and none at higher temperatures. They suggest that this difference arises from different sorption velocities arising from different energies of activation. The *ortho-para* conversion was studied by a similar method to that described above. It was found that the Bose-Einstein statistics applies to the diplogen nucleus, and that the most probable value of the nuclear spin is 1.

Synthesis of the Aldohexoses. When Emil Fischer established the constitutional formula of glucose he was able to forecast the existence of fifteen other aldohexose sugars, differing only in the stereochemical arrangement of their H and OH groups. Fischer set to work to synthesise these—since only four of them occur in Nature—and succeeded in making twelve of the isomerides. Two more, *d*-allose and *d*-altrose, were added in 1910 by Levene and Jacobs consequent on their discovery of *d*-ribose. This chapter of carbohydrate chemistry is concluded by the synthesis, described in the May number of the *Journal of the American Chemical Society* by Austin and Humoller, of the sixteenth and the last remaining aldohexose to be synthesised, *l*-altrose, the same authors having announced the synthesis of *l*-allose some months previously. The epimeric pair were obtained from *l*-ribose by the cyanhydrin reaction, *l*-ribose being produced by the action of perbenzoic acid on the unsaturated arabinal formed from the accessible pentose *l*-arabinose. Both *l*-allose and *l*-altrose were obtained crystalline, and in the same journal Phelps and Bates announce the preparation in crystalline form of *d*-allose, making the ninth aldohexose to be obtained crystalline, the others which have been so obtained being the *d* and *l* forms of glucose, mannose and galactose.

The First Parsons Steam Turbine

THE jubilee of the first Parsons steam turbine and high-speed generator, as we have already noted (NATURE, Jan. 20, p. 97), falls this year. To mark the event, the original turbo-generator, which is preserved appropriately at the National Museum of Science and Industry at South Kensington, has been moved to a prominent position near the main entrance, where it now forms the centre of a special exhibition, which will be continued for several weeks. This also includes copies of the original patent specifications of 1884; a photograph of the portrait of Sir Charles Parsons, who died on February 11, 1931, painted by the late Sir William Orpen; a chronological table detailing numerous steps in the progress of this type of prime mover, now the most important, with which the name of Parsons will always be linked; and a set of transparencies showing a few of the outstanding stages in the fifty years' development of power-generation with the Parsons turbine on land and sea, such as the Forth Banks, Elberfeld, Carville, Barking, Brimsdown and Dunston Power Stations and the *Turbinia*, *Viper*, *Dreadnought*, *Mauretania* and *King George V*, all vessels of outstanding interest.

Fig. 1 shows the original turbo-generator of 1884 which ran at the unprecedented speed of 18,000 R.P.M. and developed about 10 H.P. This small set, less than six feet long, is the direct forerunner of the large reaction type turbo-generators used to-day in all parts of the world, culminating in the 160,000 k.w. pure reaction, cross compound set erected in 1928 at the Hell Gate Power Station, New York.



Copyright] [*Science Museum*

FIG. 1. Parsons' original steam turbine with dynamo, at the Science Museum. The cover of the turbine is lying in front. The broken line on the right represents a 2-ft. rule.

Visitors to the Science Museum are also referred to other early Parsons turbines which are preserved there, notably the 120 k.w. radial flow turbine installed in 1891 at the Cambridge Electric Light Station, the first condensing turbine, which surpassed in efficiency and economy the equivalent reciprocating steam engine; the original radial flow Parsons turbine from the famous S.Y. *Turbinia*, and the after-half of the *Turbinia* itself with the parallel-flow turbines on three shafts which enabled it to attain the record speed of more than 34 knots in 1897.

Annual Visitation of the National Physical Laboratory

ON June 26, the General Board of the National Physical Laboratory made its annual inspection of the Laboratory. Many visitors, including members of scientific and technical institutions, of Government departments and of industrial organisations were present, and were received by Sir F. Gowland Hopkins, president of the Royal Society and chairman of the Board; the Right Hon. Lord Rayleigh, chairman of the Executive Committee; and the director, Sir Joseph E. Petavel.

In the Physics Department several researches are in progress for the benefit of the refrigeration industry. The laws of heat transfer between an air stream and gilled pipes are being studied; the viscosities of various refrigerants are being determined over a wide range of temperatures; and the thermal conductivities of materials used in the construction of containers for solid carbon dioxide are being measured at the working temperatures.

An interesting investigation is the study of the

discharge of air from ports in the side of a duct such as is used in the cooling of a stores. Measurements have been made on the outflow and the direction of discharge from a series of ports in a single duct, and it has been found that the quantity and direction of air issuing from a port depends on its position downstream. For certain ratios of port area to cross-section of duct, the maximum discharge can occur at the port farthest downstream.

In the same Department experiments have been made to determine the specific heat of carbon monoxide up to a temperature of 1900° C. by the velocity of sound method. A quartz crystal in the form of a rectangular parallelopiped is arranged to vibrate in either of two modes, giving frequencies of the order of 8,000 and 27,000 cycles per second. The train of waves generated is sent up a heated tube and reflected by a movable graphite piston; the positions of the reflector at which resonance occurs determine the wave-length of the sound. These positions, which are detected by the reaction of the reflected wave on the crystal, can be determined with considerable accuracy.

Attention has been given to the conditions necessary to secure the highest possible precision in the standardisation of platinum thermo-couples. At the freezing point of gold (1063° C.) considerable improvement has been obtained by immersing the crucible containing the gold ingot in a thermostatically controlled bath of molten silver. The method is being employed for other fixed points on the scale; the apparatus used for standardisation at the freezing point of silver was exhibited.

In the Radiology Division extensive work has been carried out on the application of X-rays to industrial research. A technique has been developed to discriminate between strained crystals and extremely small crystals, both of which are characterised by broad diffuse lines in the X-ray pattern. An X-ray examination of various magnet steels has shown that high coercive force is usually accompanied by considerable lattice strain, while low hysteresis loss is generally associated with a crystal structure free from strain. Work has been continued on the experimental realisation of the X-ray unit of quantity, the röntgen, and the accuracy of its determination at the Laboratory is now of the order of $\pm$ 0·5 per cent. Photographic methods of evaluating X-radiation in röntgens are being studied; and the problem of measuring gamma rays in röntgens, for purposes of radium dosage, is being investigated.

The new Acoustics Laboratory of the Department is now in use and was open for inspection. The new laboratory, which comprises a reverberation chamber and two rooms designed for transmission measurements, together with the necessary auxiliary measurement rooms, provides unique facilities for the study of the absorption and transmission of sound using larger scale specimens of materials than has hitherto been possible. The rooms, which are asymmetric in plan and elevation, and isolated both electrically and acoustically to as high a degree as possible, will facilitate in particular the study of noise transmisson and abatement in relation to the design and construction of walls and floors of modern buildings.

The differential colorimeter developed in the Optics Division for use with transparent materials has proved valuable in the accurate comparison of transparent samples of almost identical colour. Modifications are being introduced to permit similar comparisons to be made between opaque materials. An experimental model of a colorimeter, in which the human eye is replaced by a photoelectric cell in combination with suitable colour filters, was exhibited. The instrument gives promise of great utility in certain branches of colorimetry, and is especially useful for the rapid evaluation in international units of the comparative values of similar colours.

In the Electrical Standards Division of the Electricity Department, a study has been made of the use of the multivibrator circuit for the production of frequencies which are an exact submultiple of those of the standard frequency. The method has been successfully applied to the production of a series of standard audio frequencies, and to the derivation of seconds impulses from the tuning fork without the use of a phonic motor. An investigation is also in progress into the variation of the inter-electrode capacitance of valves with changes in operating conditions, a property which is of importance in connexion with the frequency stability of oscillators. It is worthy of note that in a recent comparison of radio-frequency standards, made simultaneously on a standard broadcast wave by the Laboratory and several continental laboratories, agreement was obtained to within one part in one million.

In the High Voltage Laboratory apparatus is in use for producing and measuring high transient voltages. An impulse generator, capable of yielding voltages up to one million volts, is used in this work; the measurements are made with a high-voltage cathode ray oscillograph. The surge characteristics of insulators, dielectrics, and electrical machines, will be investigated. The work has necessitated the development of control circuits to synchronise the operation of the oscillograph with the impulse to be measured.

The photometry of luminous discharge tubes has become a matter of importance, owing to the increasing use of such tubes, more especially for street lighting purposes. The measurement of their luminous efficiency presents considerable difficulty, because of the marked difference in colour between the tubes and the Laboratory standards of candle power. A study has been made in the Photometry Division of the best methods available for carrying out such measurements.

In the Radio Department methods have been developed for the automatic recording, by radio echo-sounding, of the equivalent height of reflection from the ionosphere. Some of the records obtained were exhibited. The application of the cathode ray direction finder to the location of the place of origin of atmospherics has been investigated. The experience gained at the Radio Research Station, Slough, in the study of these problems has been applied to the design of a compact direction finder for use, at ranges up to ten miles, as a collision preventer in foggy conditions at sea. The equipment comprises two frame aerials, the signals from which are amplified by two identical amplifiers before being applied to the oscillograph. The movement of the spot on the fluorescent screen shows, instantaneously, the direction from which the signals emanate.

The Department has been responsible for extensive work on the electrical properties of soil and liquids, at wave-lengths of the order of 1 metre. A method has been developed involving the investigation of the standing waves on a pair of Lecher wires which are partly immersed in the soil or the liquid. The ratio of the distances between the nodes either of potential

or of current, outside and inside the substance, determines the dielectric constant of the substance.

In connexion with the problem of frequency stability, apparatus has been devised for investigating the variation with temperature of the electrical constants of condensers and inductance coils. The specimens under test are heated artificially with hot air, and their inductance and capacitance are determined by reference to a standard inductor or capacitor the temperature of which is controlled thermostatically.

In the Metrology Department, recent determinations with the wave-length comparator have given values for the yard and the metre in terms of the wave-length of the red radiation from cadmium. The accuracy obtained in the optical measurements of length was from one to two parts in a hundred million. The measurements, which were made both *in vacuo* and in dry air free from carbon dioxide, also gave a value for the refractive index of the air. The apparatus is being used to obtain more precise information concerning the influence of variable atmospheric factors, such as temperature, pressure, humidity and carbon dioxide content, on the refraction and dispersion of air. A new Fabry-Perot interferometer of the variable gap type has been constructed for use in making precise intercomparisons of wave-length under controlled temperature conditions *in vacuo*, and for the examination of possible alternatives to the cadmium radiation.

A new type of free pendulum clock has been developed in the Department. The pendulum, swinging *in vacuo*, is maintained by regular electrostatic impulses controlled by a photoelectric cell to give constant amplitude and very precise seconds signals. An intercomparison of this clock with the other frequency standards will afford valuable information concerning the true behaviour of the various time-keeping devices.

In the Engineering Department, research on the resistance of metals to fatigue stresses occupies an important place. In particular, combined fatigue stresses, such as are encountered in engineering practice, have received attention. A study has been made of the behaviour of similar single crystals of aluminium subjected to reversed bending, to reversed torsion, and to a combination of both types of stress; the results have confirmed the general applicability of the resolved shear stress law. Fatigue tests on various metals *in vacuo* and in air have established that, in general, the exclusion of air increases the resistance to fatigue. Subsequent work, in which both dry and damp air have been used, has indicated that the decrease in strength in air is mainly due to water vapour, acting either directly or as a catalyst.

An investigation into wheel impact is being carried out in the Department on behalf of the Roads Research Board; apparatus has been devised for fitting to self-propelled vehicles of normal design. The measuring equipment consists of electrically recording accelerometers and spring-load gauges, fitted to the rear axle. By means of specially designed electrical circuits, these instruments are made to yield a current proportional to the instantaneous force in either wheel; this current is recorded oscillographically. A six-wheeled lorry equipped for impact tests was exhibited.

The research on the pressure of wind on structures has been extended to include the study of the modification of wind pressure produced on a building by the shielding effect of adjacent buildings; model buildings mounted in a small wind tunnel are being used. In the case of models with roof inclinations of $23\frac{1}{2}°$, it has been found that in general, the stresses on the roof of the shielded building are reduced by the proximity of other buildings. In the case of a building shielded by two others between which there is a narrow gap, it has been found that the suction on the windward side of the roof is even greater than that in the case of a single building freely exposed to the wind. The effect of roof shape is being examined.

The Department is investigating the relative merits of stainless steel and mild steel journals under conditions of ring oiling, and journals made of the two steels have been tested in a journal-friction testing machine. Given similar surface conditions, there appears to be little difference between their performance; the amount of friction appears to depend on the surface condition of the journal. Apparatus employing an optical lever method and capable of high precision has been constructed for studying the roughness of journal surfaces. Curves obtained with it revealed the irregularity of the surface of a polished steel journal.

In the Metallurgy Department, an investigation is being made into the constitution of light alloy systems; for example, magnesium alloys. In this work the addition of cadmium to magnesium alloys has been found advantageous, and a study is being made of the constitution and mechanical properties of alloys of magnesium with cadmium and aluminium. The work on grain size in aluminium castings has been continued; in this connexion the aluminium-titanium system has been examined. Specimen castings of aluminium and aluminium alloys showing the influence of various factors on grain size were exhibited in the foundry. Work is also in progress on the constitution of alloys of iron with reference to the use and properties of special steels. In this connexion the constitution and transformations, in the solid state, of iron rich in manganese are being examined.

A systematic study is being made of the solubility of gases in certain metals, a matter of considerable importance for the soundness of ingots and castings. A molybdenum-wound furnace used for work on gases in iron was exhibited. On account of the permeability of refractory materials to gases, the amount of refractory material in the furnace is reduced to a minimum. The furnace is enclosed in a water-cooled silica vessel.

The influence of surface oxide-film on the free passage of gases into and from molten metals is being examined. A new horizontal electron diffraction apparatus has been constructed for the examination of films in process of formation. The problem of the oxide inclusions in steel is being investigated by two methods. In one method, steel samples are fused *in vacuo* in a graphite crucible, the evolved gases being pumped off and analysed; in the other method, solution in a dry alcoholic solution of iodine out of contact with the air is used.

In the Aerodynamics Department, the research on wing-body interference has reached a stage at which the streamline bodies previously used have been replaced by models of typical aircraft fuselages. Two bodies, of the open cockpit and cabin type respectively, are being studied with and without the airscrews in operation.

Apparatus has been designed in the Department for obtaining the time-history of the rapid change in lift which an aerofoil experiences when the angle of incidence is suddenly altered. Such transient forces

are of importance in connexion with the effect of gusts on wing-load. The angle of incidence of the aerofoil under test is rapidly altered by a spring mechanism; the resulting change of lift on the aerofoil is recorded piezo-electrically.

Much work is being done in the Department on turbulent airflow. Extensive use is being made of shadowgraph methods in which the motion of spots of hot air produced by electric sparks is observed photographically. Apparatus has been devised for obtaining cinematograph records of the air flow, and in this work the *Schlieren* method of photography has proved of assistance.

The equipment of the Department has been augmented by the construction of a high-speed wind tunnel operated from the exhaust of the compressed air tunnel. This tunnel, which is one foot in diameter, is expected to give wind speeds in the neighbourhood of 950 ft. per second. The tunnel is to be used for the study of the behaviour of aerofoils at high wind speeds, with particular reference to the aerodynamic efficiency of the tip sections of airscrews at high speeds.

The William Froude Laboratory is engaged on extensive research on the manœuvring of ships. The work has shown that in certain cases, the performance of a rudder can be considerably improved by an alteration in propeller design. The effects of introducing a fin in front of the rudder are being investigated in the case of single-screw ships. A model of a single-screw vessel equipped with apparatus for measuring steering qualities was exhibited.

For research on propeller efficiency, a 24 ft. wooden model of a single-screw cargo ship has been constructed, complete with self-propelling gear and automatic recording apparatus for measuring the thrust capacity of propellers. The model is available for testing propellers of any design. A closed circuit tunnel for research on model propellers—the gift of Sir James Lithgow—has been added to the Department. The new tunnel will facilitate the study of the action of propeller blades, with particular reference to the cause of erosion. Stroboscopic methods are provided for observing the propeller while it is in motion.

Jubilee of the Junior Institution of Engineers

THE Junior Institution of Engineers celebrated its jubilee on June 27–29. The Institution was founded in 1884 by a group of young engineers employed at the works of Messrs. Maudslay, Sons and Field of Lambeth, and it has always fostered "the Junior spirit". Open to men of all ages engaged in any branch of engineering and allied professions, it demands no examination of its members, and its meetings and discussions are marked by an absence of formality. Its first president was Mr. Freke Field, a grandson of Joshua Field (1787–1863), the partner of Henry Maudslay, who himself in 1818 was the first chairman of the newly founded Institution of Civil Engineers, and its president in 1848. The successors of Mr. Freke Field have included the late Sir Alexander Kennedy, John Perry, Silvanus Thompson, Sir William White, Lord Moulton, Sir Dugald Clerk, and many other distinguished men still living, eleven of whom were present at the luncheon at the Hotel Victoria on June 27 with which the jubilee proceedings were inaugurated, and at which Mr. W. J. Tennant, the present president, presided.

The luncheon on Wednesday was followed by a special service in St. Paul's Cathedral attended by the Institution as "an act of thanksgiving for 50 years of steady progress and attainment"; a reception at the Mansion House by the Lord Mayor and Lady Mayoress, and a conversazione at the Science Museum, South Kensington. A special exhibition of models, tools and drawings relating to the Lambeth firm, and to men who had been associated with it, had been arranged, and during the course of the evening an illustrated lecture on Maudslay, Sons and Field and the Royal Navy, was given by Eng.-Capt. Edgar C. Smith. After a brief reference to the formation of the institution and the world's great debt to young inventors and engineers, of which there were many notable illustrations in the Museum, Capt. Smith said that the history of the firm of Maudslay is of interest for many reasons; first, because of the many eminent engineers who built up its fortunes and maintained its traditions; secondly, on account of its work as a training school for mechanical engineers; thirdly, because it recalls a time when marine engineering was a flourishing industry on the Thames, carried on not only by Maudslays but also by Penn, Humphry, Miller, Ravenhill, Rennie, Seaward and others; and lastly, as the firm which during the nineteenth century supplied more marine machinery to the Royal Navy than any other.

The first vessel engined for the Navy by Maudslays was H.M.S. *Lightning*, 1823, and she was succeeded by such notable vessels as the *Rhadamanthus*, the first steam man-of-war to cross the Atlantic, the *Terrible*, the largest paddle wheel frigate, the *Rattler*, the first steam screw-driven man-of-war, the *Marlborough*, the *Iris and Mercury*, the *Blake* and many others. In all the various changes and advances in marine propulsion, Maudslays played a great part, and the last engines constructed by them represented the highest pitch of mechanical engineering during the nineteenth century.

The events of Thursday included a visit to the Cricklewood works of Smith's English Clocks Ltd., and the delivery by Sir Frank Smith, secretary of the Department of Scientific and Industrial Research, of the Gustave Canet Memorial Lecture of the Institution at the Royal Society of Arts. This lecture was founded by Madame Canet, the widow of Gustave Canet (1846–1908), the distinguished French ordnance engineer who died while he was holding office as president of the Institution.

Sir Frank Smith took as his subject "The Engineer and Modern Civilisation". The structural engineer of early times, he said, carrying out great works without a knowledge of science, either consciously or subconsciously followed the principles which Nature pursues in creating our own structures. The engineer of to-day is distinguished from his predecessor inasmuch as he studies structures of microscopic size as well as those of gigantic proportions, and in this way is able to improve his materials and discover new ones. Modern civilisation, he continued, is a blend of two cultures: the engineering culture embracing the sciences, industry and commerce, and an idealistic culture including the fine arts and philosophy. What distinguishes so markedly our modern civilisation from that of a hundred or even fifty years ago is that

the materialistic culture is much more advanced than ever before.

The composite work which makes up our civilisation looks quite different when seen through the spectacles of an electrical, civil or mechanical engineer. The first would point to the vast output of electrical machinery and appliances, the second to the great railways, bridges and dams, and the last to inventions which made possible the developments of tools and machines. It was Maudslay's slide-rest lathe and Whitworth's accurate straight-edges and surface-plates which made it possible to construct the modern internal combustion engine.

There is also a picture of labour displaced by machinery; sweeping economies in labour being made in factories, mills and offices. With mechanical equipments on farms, 1,000 acres can be ploughed, prepared and sown in a single day, and ten minutes of human labour suffices to produce a bushel of wheat whereas formerly three hours were required. The pleasant picture of the English country-side a century ago with its hay wains and reapers was accompanied by another of long hours and child labour in factories. The engineer by his inventions has made child labour unnecessary and farm work less exacting; many who pine for 'the good old days' labour under deceptions similar to those which often mislead travellers in tropical countries—they see mirages of oases in plenty in the rear while the real oases lie right ahead. Stuart, more than a century ago, estimated that the steam engines in use in Great Britain developed more power than 4,500,000 labourers; to-day, steam turbines develop more power than 450 millions of Stuart's labourers, while in the United States it is estimated that every individual has an average of 900 such 'slaves'. The engineer, too, has banished the fear of famine; he has supplied fertilisers for the soil, agricultural machinery of wonderful efficiency, transport facilities of remarkable speed, and cool controlled atmospheres for keeping food fresh and palatable over long periods. At the conclusion of his lecture, Sir Frank Smith was presented with the Gustave Canet Gold Medal.

University and Educational Intelligence

Birmingham.—On June 30 the honorary degree of LL.D. was conferred on the following, among others: The Right Hon. the Earl of Derby, Chancellor of the University of Liverpool; Sir John Cadman, emeritus professor of mining in the University, chairman of the Anglo-Persian Oil Company; Sir Harry McGowan, president and chairman of Imperial Chemical Industries, Ltd.; Dr. G. T. Morgan, director of the Chemical Research Laboratory, Teddington; Prof. C. A. Lovatt Evans, Jodrell professor of physiology, University College, London.

The following appointments have been made: Philip Cloake, joint professor of medicine, to succeed Prof. J. G. Emanuel who has resigned; J. M. L. Burtenshaw, lecturer in bacteriology; T. G. Hunter, assistant lecturer in oil engineering.

Cambridge.—In the annual report of the Committee of Management of the Scott Polar Research Institute it is stated that the formal opening of the new buildings will take place in the autumn, probably on November 16, when the Chancellor of the University (Mr. Stanley Baldwin) has consented to perform the opening ceremony.

The Harkness Scholarship, valued at £150, awarded for proficiency in geology, has been won by J. K. S. St. Joseph, Bromsgrove and Selwyn. The Wiltshire Prize for geology and mineralogy in connexion with Part I of the Natural Sciences Tripos has been awarded to S. O. Agrell, Bedales and Trinity Hall.

The Frank Smart Prizes have been awarded to G. C. Evans, St. John's (botany), who was placed in Class I in Part 2 of the Natural Sciences Tripos and A. L. Hodgkin, Trinity (zoology and comparative anatomy), who was placed in Class I in Part 1 of the same tripos.

At Magdalene College D. Purdie Kings has been elected to the Charles Kingsley bye-fellowship.

At St. John's College the following have been elected into fellowships:—Dr. M. L. O. Oliphant, of Trinity College, Messel research fellow of the Royal Society, and O. A. Trowell, formerly scholar of St. John's College, University demonstrator in physiology.

Durham.—At the June Convocation held on June 27, the honorary degree of D.Sc. was conferred on Prof. A. Fowler, professor of astrophysics in the University of London.

Edinburgh.—On June 28 the honorary degree of LL.D. was conferred on the following, among others: Dr. Robert Hutchison, physician to the London Hospital; Prof. Robert Robinson, Waynflete professor of chemistry in the University of Oxford; Dr. Theobald Smith, emeritus director of the Department of Plant Pathology, Princeton, New Jersey, former director of the Rockefeller Institute; Sir John Maxwell Stirling-Maxwell, formerly chairman of the Forestry Commission and chairman of the Ancient Monuments Board (Scotland); Prof. D'Arcy Wentworth Thompson, professor of natural history in the University of St. Andrews.

The degree of D.Sc. was conferred on the following for the theses indicated: G. H. Bates ("Semi-Natural Vegetation and the Biotic Factor"); Charles Ockrent ("Studies in Active Charcoal"); C. M. Scott ("The Sensitivity of Cells to the Lethal Action of X-Rays"); George Taylor ("An Account of the Genus *Meconopsis*"); Dr. S. A. Kinnier Wilson ("The Experimental and Applied Physiology of the Corpus Striatum").

London.—The Kent County Council has decided to make a grant of £40,000, payable over ten years, towards the cost of erecting new University buildings on the Bloomsbury site, and the Worshipful Company of Butchers has made a grant towards the Ceremonial Hall.

St. Andrews.—On June 29, the honorary degree of LL.D. was conferred on the following, among others: Lord Moynihan, emeritus professor of surgery in the University of Leeds; and Sir Frederick Gowland Hopkins, president of the Royal Society.

Mr. Ivor Griffiths and Mr. P. Jacobs have been awarded Streatfeild scholarships under the Royal College of Physicians and the Royal College of Surgeons to carry out an investigation into the tonsil, its anatomy, physiology, and the relations of its lymphatic vessels.

Science News a Century Ago

Launch of S.S. *John Randolph*

On July 9, 1834, the *John Randolph*, the first iron steam vessel in the United States, was launched on the Savannah River. She had been built by John Laird at Birkenhead and sent to the United States in sections. She was 110 ft. long, 22 ft. beam, and drew about $2\frac{3}{4}$ ft. Her tonnage by the builders' old measurement rules was about 250 tons. Her engines, of 60 horse-power, had been made by Fawcett, Preston and Co., of Liverpool. The first iron vessel had been built so long before as 1787, but iron shipbuilding made slow progress. There were many objections raised against the use of iron, but practical experience proved most of them to be ill-founded. In the end, iron ships proved lighter and faster than wooden ships, cargoes could be stored more easily and kept in better condition in them, they were more easily repaired, and when fitted with watertight bulkheads were far safer. The pioneers of iron shipbuilding in Great Britain included John Grantham, Sir William Fairbairn and David Napier, but none did more important work in this direction than John Laird.

Death of Capt. David Thompson

"We have just received the intelligence," said the *Athenæum* on July 12, 1834, "of the decease at Mauritius of the well-known computer and author of the Lunar and Horary Tables and inventor of the Longitude Scale, in consequence of severe injuries received during the hurricane which recently devastated that colony.

"The work which brought Captain Thompson's name into notice among men of science, is his solution of the problem, of clearing the apparent distance of the moon from other celestial bodies, from the effects of parallax and refraction—one of the most useful in nautical astronomy; and he received from the late celebrated Baron de Zach, high commendation for his skill and success in this investigation, and from the late Board of Longitude, a tardy acknowledgement of the high merit of his Tables. . . ."

David Douglas, 1798–1834

On July 12, 1834, David Douglas, the Scottish botanical collector who discovered 'Douglas spruce', was killed in the Sandwich Islands. On an excursion he inadvertently fell into a pitfall set for wild cattle and was gored to death by a bull. Born at Scone in Perthshire, the son of a stone-mason, he became a gardener, and while employed at the Botanical Gardens, Glasgow, attracted the attention of J. W. Hooker, then professor of botany, and accompanied him on some of his expeditions. He was recommended to Sabine, the secretary of the Royal Horticultural Society, and sent to the United States, where he procured many fine plants. Sent out again in 1824, during the next three years he went as far as north California and the River Columbia, and then made his way to Hudson's Bay, whence he returned with Sir John Franklin. It was during this expedition that he discovered the spruce which bears his name. His third and last expedition began in 1829. After spending a part of the years 1832–34 on the Fraser River, he sailed for the Sandwich Islands. It is said he introduced into Great Britain fifty-three new woods and one hundred and forty-five new herbaceous plants of a hardy nature. He was a fellow of the Linnean, Geological and Zoological Societies and after his death the botanists of Europe erected a monument to him at Scone. A monument to him was also erected in the cemetery at Honolulu by J. L. Brenchley (1816–73), the traveller.

Societies and Academies

London

Royal Society, June 28. W. L. Bragg: The structure of alloys (Bakerian Lecture). An alloy phase has two characteristics. The first is the pattern of sites occupied by atoms irrespective of their nature. Each phase of an alloy system has a different pattern of sites, and therefore a change from one phase to another involves their complete re-arrangement. The second characteristic is the distribution of the atoms amongst these sites. This distribution may vary continuously without change of phase, from being random at high temperatures to being partially regular at low temperatures. The alloy is a system of dynamical equilibrium. Although interchange of atomic position at room temperature is infrequent, the alloy has received its character at some previous point in its history when the temperature was just sufficiently high for interchange to be important. Maxima and minima in physical properties at certain relative proportions, such as Fe_3Al and $AuCu_3$, are statistical effects, and do not imply the existence of corresponding compounds.

Royal Meteorological Society, June 20. Sir Napier Shaw: The natural history of weather. The paper describes an arrangement of the meteorological data for a station with special reference to the encouragement of the study of Nature. I. S. Astapowitsch: Air waves caused by the fall of the meteorite on June 30, 1908, in Central Siberia. The results of the barograph records obtained by the author at the time of his research expeditions of 1930 and 1932 are given. The time of fall of the meteorite and the force of the explosion were determined by examination of various independent sources. The air wave must have been recorded by microbarograms in Japan, China, India and perhaps America. F. J. W. Whipple: Phenomena related to the great Siberian meteor. This paper is supplementary to one published by the author in 1930. Additional evidence with regard to the illumination of the sky during the nights following the arrival of the meteor is summarised. In view of the fact that recorded observations of this phenomenon are confined to the north of Europe, the meteor probably had a tail which was to be captured by the earth's atmosphere. The air waves produced by the meteor were recorded at Batavia and at Washington as well as at several places in Europe. S. E. Ashmore: The splashing of rain. The connexion between the rate of rainfall and the splashing produced by it from a horizontal surface has been studied experimentally for a large number of surfaces which may be used as the surroundings for rain-gauges. The splashing from ice and water has also been investigated. W. R. Baldwin-Wiseman: The cartographic study of drought. This paper presents a method of setting out rainfall statistics for drought periods. In order to illustrate this method the famous drought in Queensland during 1902 has been investigated. Maps are

given defining the progress of this drought, the rainfall being expressed as deficiencies from the average for groups of consecutive months.

PARIS

Academy of Sciences, May 14 (*C.R.*, 198, 1729–1820). Gustave Moussu was elected a member of the Section of Rural Economy in succession to the late E. Roux. KAROL BORSUK: The idea of the category of L. Lusternik and Schnirelmann. SPYRIDION SARANTOPOULOS: The existence of holomorph integrals of differential equations of the first order in singular cases. BEPPO LEVI: Ensembles of points which cannot be ensembles of zeros of an analytical function of several variables. ANTONIO MONTEIRO: Additive nuclei in the theory of integral equations of Fredholm. ANDRÉ WEIL: A characteristic property of groups of finite linear substitutions. ELIE CARTAN: Remarks on the preceding communication. STEFAN BERGMANN: Integral and meromorph functions of two complex variables. MLLE. M. RENATA FABBRI: Isoconic rotations. P. SWINGS and B. EDLÉN: The presence of the forbidden lines of Ne V in the spectra of nebulæ. R. MAZET: A new definition of the forces of control. HENRI PONCIN: The sudden local variations of density in fluids in motion. J. BERNAMONT: The fluctuations of resistance in a metallic conductor of small volume. M. GUILLOT and M. HAÏSSINSKY: The effect of strong concentrations of electrolytes on the potential of the deposit of polonium. A. MICHEL-LÉVY and H. MURAOUR: The luminosity of waves of shock. A luminous effect (shown in reproductions of photographs) is produced when two shock waves meet and also when a single shock wave meets an obstacle. The spectrographic study of this phenomena is being investigated. MLLE. CÉCILE STORA: The relation between the curve of spectral sensibility and the curve of absorption in photocells with colouring matters. By comparison of the sensibility and absorption curves, it is shown that the photosensitive layer is formed of a very thin pellicle of colouring matter. The energy absorbed by this pellicle is responsible for the variation of potential under the action of light. MME. BRANCA EDMÉE MARQUES: The fractional precipitation of radiferous barium sulphate. A study of the behaviour of the system barium – radium sulphate under different conditions of precipitation. The errors due to filtration are avoided by the use of the centrifuge. The Doerner and Hoskins law holds for the case of slow precipitation. The fractional precipitation of radiferous barium salts by sulphuric acid is less efficient from the point of view of the separation of the radium than the fractional crystallisation of the bromides and chlorides. J. PERREU: The thermochemistry of aqueous solutions of nickel sulphate. MLLE. M. G. ADOLFF and H. HERING: The heterogeneous equilibria in the system: cadmium chloride, sodium chloride, water. A. P. ROLLET and J. WOHLGEMUTH: Study of the binary system: water, lithium hydrazoate. HENRI MULLER: Applications of the method of the lowering of eutectic points. WILFRIED HELLER: The conditions of a mechanical coagulation. IVAN PEYCHÈS: Contribution to the study of beryllium tartrate. The results of measurements of the rotatory power. ANDRÉ DE PASSILLÉ: The method of preparation of pure arsenic. Ammonium arsenate, after purification by repeated recrystallisation, is reduced by heating in ammonia at 1,000° C. and freed from traces of the oxide by sublimation. The arsenic thus obtained proved to be spectroscopically pure. GEORGES DENIGÈS: A new reaction of cantharidine, applicable to its estimation by colorimetry. The method is based on the brown coloration produced by heating with formol and sulphuric acid. E. M. BELLET: The alcoholysis of glycerol triacetin in weak alkaline solution. HENRI RAVIER: Phenyltrimethylglycerol and some chlorhydrins of tetrasubstituted glycerols. A. ABLOV: The influence of the electric moment on the number of molecules of base fixed by a salt. C. LEFÈVRE and CH. DESGREZ: Contribution to the study of the organic sulphides. MICHEL FLANZY: The formation of formaldehyde in the oxidation of ethyl alcohol. The production of formaldehyde as an oxidation product of pure ethyl alcohol is proved: the presence of methyl alcohol is not proved by this reaction. MLLE. SIMONNE CAILLÈRE: Observations on the chemical composition of the palygorskites. RAYMOND FURON and CONRAD KILIAN: The Primary and Cretaceous between Tibesti and Aïr. J. GAUZIT: Concerning the theoretical discussion on the distribution of ozone in the atmosphere and the *Umkehreffekt*. J. VELLARD: The periodic destruction of the fauna of the rivers of the Grand Chaco by variations of salinity. The fish die as the salinity increases through evaporation and are deposited in enormous blocks. This is of interest from the geological point of view as it gives a possible explanation, better than any other hypothesis, of the formation of certain banks of fossil fishes, the origin of which is otherwise difficult to understand. ALPHONSE MALAQUIN: New observations on the germinal strain of the annelid *Salmacina Dysteri*. MLLE. M. L. VERRIER: The action of light on visual purple. The decolorising action of light is only appreciable if working with retinas poor in visual purple or on very dilute solutions: if the visual purple is abundant the action is practically nil. These results are difficult to reconcile with the current view of the mechanism of the visual purple. JACQUES POCHON: The influence of the culture medium on the biological properties of a cellulolytic bacterium from ox stomach. BORDIER: The measurement of the lucimetric index of a given place by a helio-chromometer. The measurement is based on the amount of iodine set free from a solution of iodoform in chloroform. B. S. LEVIN: The influence of oxygen on the antitoxic action of cholesterol on the saponins. MICHEL POLONOVSKI, PAUL BOULANGER and GASTON BIZARD: The formation of ammonia at the expense of aminoacids in the kidney of the dog *in vivo*. An important proportion of the urinary ammonia arises from the natural aminoacids.

LENINGRAD

Academy of Sciences (*C.R.*, No. 7). S. BERNSTEIN: The linear quasi-continuous chains of Markov. I. VINOGRADOV: Distribution of primitive roots. S. MICHLIN: Dirichlet's problem for a domain with several closed boundaries. D. SHERMAN: A problem of the theory of elasticity for domains with multiple connexions. A. POPOV: A note to the paper by V. Fock "Zur Berechnung des elektromagnetischen Wechselstromfeldes bei ebener Begrenzung" (*Ann. Phys.*, 17, 4; 1933). V. PAJEVSKIJ: A general expression for the probability of survival under the mortality conditions of a given calendar period. For practical computation, the following formula may be used:

$$q_{12}^2 = q_{12} - 2 \cdot 4 \frac{l}{n} (6q_2 - q_{12}),$$

where q_2 and q_{12} denote the values of probabilities of dying before the age of 2 and 12 months respectively, l the monthly increase in the number of births, and n the average monthly number of births. M. BRONSTEIN: The relativistic generalisation of the principle of uncertainty. G. KRUTKOV: Contribution to the theory of Brownian movement. On the function $f(v,x,t)$ and the equation of the diffusion. V. KUZNETSOV, D. KONVISAROV and V. STROKOPYTOV: The increase in the plasticity of metals during plastic twisting in alternating directions. K. ANDREJEV and J. CHARITON: Some considerations on the mechanism of self-propagating reactions. A certain minimum degree of localisation of the reaction energy is necessary for the self-propagation of the macro-chain. M. KAZNELSON and M. KABACHNIK: Amidation with the help of sodium and potassium amides in the alkaloid series (1). On the α-aminoanabasin. V. SADIKOV, V. VADOVA and R. KRISTALLINSKAJA: The use of H_2SO_4, HCl, H_3PO_4, HNO_3 and of alkalis in the catalytic splitting of proteins. I. LIASCHENKO: Flowering in the genus *Cucurbita*. Description of hermaphrodite flowers observed in four different species. N. KALABUCHOV: 'Anabiosis' in vertebrates and insects at a temperature below zero. At temperatures of $-3°$ to $-10°$ C., metabolic exchange continues, though very slowly; consequently, the state of prolonged undercooling is only a profound torpor, and not a complete cessation of the vital processes understood by 'anabiosis'. L. VARDANIANC: On the age of the surface relief of Ciscaucasia. The conformation was produced only in the post-Pliocene.

ROME

Royal National Academy of the Lincei, Jan. 21. S. MINETTI: Riccati's differential equation and certain results in differential geometry. A. MYLLER: The flexion of scored surfaces. L. SOBRERO: A new hypercomplex variable of interest in the theory of elasticity (1). R. CACCIOPPOLI: Elliptic equations with partial derivatives, with n independent variables. Various simple fundamental results concerning linear equations of elliptic type are established. E. BOMPIANI: Determination of the hyperspacial surfaces for a triply infinite system of normal rational curves. R. ZAÏCOFF: Generalised wave mechanics. F. P. MAZZA and L. PANNAIN: Mechanism of the action of histozyme. This enzyme is distinguished from the carboxypeptidases, as it unites, not with the free carboxyl group of the substrate, but with the nitrogen of the CO.NH bridge. The different activities it shows towards aliphatic and aromatic alcyl derivatives are probably due, not to the existence of two different enzymes, but to varying velocity of the hydrolysis catalysed by the enzyme. F. PIRRONE: (1) Studies on indones. Synthesis of β-phenyl-1:2-naphthoindene-11-one. (2) Investigations in the field of high frequency. Biochemical action of ultra-short electromagnetic waves (1). Exposure of brewers' yeast in aqueous suspension to the oscillations of a Hertzian resonator capable of oscillating on the fundamental wave of $\lambda = 1{\cdot}885$ metre reveals a slow accelerating action on the development of the yeast. The effect is slight after 1–2 days, but becomes marked after 6–7 days. G. BINI: Determination of the characteristic nitrogen groupings in the muscular tissue of *Mullus barbatus*, L. The proportions of the total nitrogen of this tissue existing as lysine, histidine, arginine, etc., have been determined by the van Slyke method. C. SIBILIA: Sexuality in certain species of the genus *Chaetomium*. This genus includes many homothallic species, and experiments are being made to ascertain if such homothallism is absolute or prevalent. A. DE AGAZIO: Action of strychnine and strophantine on the isolated heart of *Bufo vulgaris*. ELENA J. ROLAND: Existence of a large sebaceous gland in the external auditory canal of native *Mus* species.

Forthcoming Events

ROYAL SANITARY INSTITUTE, July 9–14.—Health Congress to be held at Bristol. Dr. Stanley H. Badock: President.

INSTITUTION OF NAVAL ARCHITECTS, July 10–13.—Summer meeting and International Conference on Experimental Tank Work. Right Hon. Lord Stonehaven: President.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES, July 11–14.—Annual Congress to be held at the University of Reading.

July 11, Prof. H. L. Hawkins: "Fossils and Men" (Presidential Address).

July 13, Prof. E. B. Poulton: "The Power of Changing Colour as a Form of Protective Resemblance" (Public Lecture).

INTERNATIONAL FEDERATION OF EUGENIC ORGANISATIONS, July 18–21.—Biennial Conference to be held at Zurich.

Prof. Ernst Rüdin: "Racial Psychiatry—a Scheme for Topographical Research in Europe" (Presidential Address).

Official Publications Received

GREAT BRITAIN AND IRELAND

Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, 1934 June 2. Pp. 22. (Greenwich.)

Report for 1932 (No. 41) on the Lancashire Sea Fisheries Laboratory at the University of Liverpool. Edited by Dr. R. J. Daniel. Pp. 133+2 plates. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd.) 5s.

Imperial Institute. Annual Report 1933, by the Director, Lieut.-General Sir William Furse, to the Board of Governors. Pp. 56. (London.) 2s.

Committee on Bird Sanctuaries in Royal Parks (England). Report for 1933. Pp. 24. (London: H.M. Stationery Office.) 6d. net.

OTHER COUNTRIES

Mémoires du Musée Royal d'Histoire Naturelle de Belgique. Hors Série. Résultats scientifiques du voyage aux Indes orientales Néerlandaises de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. Publiés par V. Van Straelen. Vol. 2, Fasc. 9: Parapcripatus Leopoldi nov.nom. By E. Leloup. Pp. 16+1 plate. Vol. 2, Fasc. 10: Trématodes. By Robert Ph. Dollfus. Pp. 16+2 plates. Vol. 3, Fasc. 8: Rhizocéphales. By H. Boschma. Pp. 8+1 plate. Vol. 3, Fasc. 9: Terrestrial Isopods. By H. Gordon Jackson. Pp. 8+2 plates. Vol. 3, Fasc. 10: Cirripedes (additional part). By Dr. C. A. Nilsson-Cantell. Pp. 8. Vol. 3, Fasc. 11: Ascidies. By H. Harant and Od. Tuzet. Pp. 6. Vol. 4, Fasc. 1: Heterometabola I. Pp. 85. Vol. 4, Fasc. 2: Neuroptera. Pp. 15. Vol. 4, Fasc. 8: Heterometabola III. Pp. 70+3 plates. Vol. 4, Fasc. 9: Coleoptera II. Pp. 57+1 plate. Vol. 5, Fasc. 2: Reptilia. By L.-D. Brongersma. Pp. 39+4 plates. (Bruxelles.)

Suomen Geodeettisen Laitoksen Julkaisuja. No. 19: The Continental Undulations of the Geoid. By R. A. Hirvonen. Pp. 89. (Helsinki.)

Reports of the Institute for Science of Labour. No. 19: Studies on the Hardness of Human Muscle, with special reference to its Value for measuring Industrial Fatigue. By Dr. Gitô Teruoka and Dr. Syôzô Eda. Pp. 9. 30 sen. No. 20: An improved "Rôken" Gas Analysis Apparatus. By Dr. Misawo Okuyama. Pp. 9+1 plate. 30 sen. No. 21: Labour Physiological Studies on the Pregnant Women. By Dr. Gitô Teruoka. Pp. 31. 60 sen. No. 22: Variations in the Physico-chemical Nature of Urine of Workers in Day and Night Shifts, by Dr. Takatugu Yagi and Miss F. Matubara; Physico-chemical Study on the Urine of the Working Girls in a Spinning Factory, by Sho Sasaki. Pp. 16. 30 sen. No. 23: Infant Mortality in relation to the Climate of Japan, Part 1. By Dr. Tujiwo Iwasaki. Pp. 18. 40 sen. (Kurasiki.)

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The Scientific Basis of Modern Life

THERE are few more distressing tokens of defective leadership than are to be found in the comparative failure of the Disarmament Conference and the obstacles with which the Conference has been continually beset. It is a significant piece of evidence of our incapacity to order our affairs in accordance with the demands of the new age—the machine power age—and to exercise the restraints inevitable in view of the immense powers now placed within our hands. It is true that the Disarmament Conference demanded a high order of political capacity—a breadth of vision, a length of foresight, a degree of detachment from our own interests, a sense of responsibility, a steadfastness of purpose, a sweep of imagination and a power of dealing with technical factors which are not easily acquired. Such qualities are largely the result of adequate training, and their absence at the Disarmament Conference is due less to the imperiousness of narrow nationalism than to our defective educational systems which fail to cultivate them, and on the contrary, often do more to suppress creativeness than to awaken it.

What is true of the sphere of disarmament is equally true of those many other difficult problems such as unemployment or disemployment or leisure with which the machine age has confronted us. Confusion of thought in the community has made followers scarce as it has impoverished leadership, and it is an urgent task to eliminate such confusion as an essential step towards world order and control.

The lecture which Prof. J. L. Myres delivered at the University of Liverpool last December on "The Man of Science and the Science of Man" is particularly worthy of the attention of scientific workers from this point of view, and not only assists materially in clarifying thought about these issues but also indicates certain definite contributions which the man of science himself must make. When we speak of the effects of scientific discoveries for good or for evil, we usually mean the effects of the use for some specific purpose of a particular application or invention based on a scientific discovery. The scientific worker concerned with the discovery itself is usually widely separated from the point at which the invention or application of his discovery for an industrial purpose is made. Very commonly this distinction is not made, and the confusion between discovery by the man of science who seeks to meet our need

for knowing more about the universe, and invention, which satisfies our desire to do, is paralleled by a possibly even more serious confusion between the inventor, who may of course be a scientific worker, and the employer or exploiter. The former knows how to produce the required effect in given conditions; the latter is concerned with the immediate solution for his own purpose of some particular problem in applied science.

The moral responsibility of the scientific worker —whether he be discoverer or inventor—for the full use of his specific gifts, has been generally recognised, but in these days some critics have overlooked the betrayal of his trust which would be involved in his failure to persist in his work of investigating Nature, and compliance with the suggestion to take a ten years' holiday. It is also sometimes rather obscured by professional habits and associations, which are apt to assume an unduly conservative attitude towards progress. The moral responsibilities of the employer or exploiter of scientific discoveries are, however, only coming to be recognised at a point at which the restraint of abuse has become extremely difficult and complicated.

While this is one reason for the difficulties which beset the elimination of warfare between civilised communities, it cannot absolve the scientific worker from his share of responsibility, both direct and indirect. Apart from his moral responsibility for endeavouring as a citizen to prevent the abuse of powers with which he ultimately provided the community, he must recognise his equally important direct responsibilities. As already hinted, one of the most serious dangers to public order at the present time is the absence of any wide diffusion of that accurate general scientific knowledge which can provide an adequate background for the life that rich and poor alike have now to live. The paucity of such knowledge in the general community in the face of the high level of technique, the necessity for accurate observation and rapid decisions demanded of us daily in crossing the streets or managing domestic appliances, etc., is a prime factor in the outbreak of economic nationalism in recent years, with its threat not merely to the collective system but also to all the finest elements in our civilisation.

This responsibility, to which Prof. Myres directs attention, is accentuated by the problems of leisure and unemployment, and inspires his eloquent appeal for expositors of science who are competent to undertake the education of the general community so as to impart something of the spirit and methods of science. It is only as an adequate general scientific background is acquired that we can expect the general citizen to form a considered judgment on political and economic affairs to-day, or to reject the addresses of those advocating mutually inconsistent policies or seeking to exploit his ignorance to their own advantage.

The gullibility of the public can only be eliminated with the help of the scientific worker, but there are several respects in which the latter must set his own house in order before he can hope for much success in the task of exposition and education. In the first place, he must recognise that he himself is not less a responsible citizen because he follows a responsible calling, and that he must exercise his powers of observing and interpreting facts, not merely professionally and technically, but also in the ordinary affairs of everyday life. If scientific workers have in the past been regarded as unfitted for high administrative positions, that view has largely been encouraged by their common indifference to such work and the attitude of superiority or aloofness they are prone to assume.

The deliberate eschewing of this attitude of aloofness would in time ensure that the scientific worker participated on equal terms in the general life of the community, making important contributions where scientific and technical factors were conspicuously involved. That scientific workers themselves would thus come to qualify in increasing numbers for leadership is, however, of less significance than the wider opportunities of education thereby opened to them. Prof. Myers is unquestionably right in urging that much current misapprehension about scientific matters, pure as well as applied, would be avoided if scientific workers were to relax reasonably and seasonably our national reluctance to 'preach' or to 'talk shop', and to put their several competences at the disposal of others.

There is implied in this, however, the deliberate break with the common tendency of professional organisations to constitute themselves a separate class with their own rites and shibboleths, and to weave a web of mystery round their doings. The sense of mystery or magic with which the man of science has often been surrounded—particularly through the medium of the daily Press—is a fatal obstacle to the development in the public mind of the attitude to science which is required in the present age. When a great man of science is

regarded rather as a great artist is regarded, with respect and admiration for his skill and ability, but not with a feeling that his work is mysterious or incomprehensible, we shall be within reach of our goal.

Prof. Myres, however, makes even more practical remarks which should be heeded by those who would be expositors of science in this way. There must not simply be the willingness to expound and the readiness to mix freely and simply with other men. If it is inevitable that the subjects of scientific articles or lectures should be abstruse or highly technical, the scientific worker might well make a much more determined effort to relate them to some purpose within the cognisance of a reasonably well-informed citizen. The neglect to make this effort has frequently exposed the man of science in the past to the charge that he is as void of a general social and cultural background as the general citizen is of a scientific background.

If the first need in such exposition is an understanding of the audience and of the range of experience and knowledge of that audience, the choice of appropriate terms for that exposition comes a close second. Few things have done more to hinder the spread of accurate scientific knowledge in this community than the widespread indifference of the man of science in this respect. It is no uncommon experience to encounter scientific papers in which the authors have made so little attempt to define their terms that their meaning is almost incomprehensible even to other specialists in that field.

What is required, however, is not the evasion of the real issue by use of more or less accurate analogies or elaborate circumlocution which we frequently find in popular writers on scientific and technical subjects. It is rather the setting of trained minds to the evaluation of the facts and their expression in terms understood by the general community. This is no impossible task. Its possibility was demonstrated by Faraday, Clerk Maxwell, Huxley and many others who wrote strong, simple and beautiful English. It does demand, however, much more accurate thinking and more precision in the choice of words than are commonly to be found among scientific workers.

The elimination of jargon, and the loose thinking which it connotes, from our scientific and technical journals would be a first step in furtherance of the work of exposition and education. The strange contrast between the precision of experimental work, and the slovenliness and ambiguity with which its results are sometimes expressed, is a stumbling block which must be removed before the education of the community in this way can proceed apace or the scientific worker discharge his responsibilities of leadership.

The points to which Prof. Myres has directed attention are concerned with the whole standard of scientific work as well as with its expression. In the long run, scientific work cannot be accurate and precise if its expression is vague and careless. Moreover, science can only continue to render its fullest service to the community as the relations between the scientific worker and the general citizen are harmonised and the purposes and methods of science are widely understood. In the establishment of such a sympathy, a nobler type of citizenship becomes possible, adequate to defend us against the dangers to which civilisation is exposed and to build a social order worthy of the limitless powers which the advance of science has put into the hands of man. The realisation of these ideals, with the widening fields of service and investigation which they offer, demands the best endeavours of all scientific workers both professionally and as citizens.

Proliferating Nomenclature of Foraminifera

A Manual of Foraminifera. By Prof. J. J. Galloway. (James Furman Kemp Memorial Series, Publication No. 1.) Pp. xiii+483. (Bloomington, Ind.: The Principia Press, Inc.; London: Williams and Norgate, Ltd., 1933.) 25*s.* net.

It is a matter open to question whether protozoologists, who concern themselves with the bionomics of the Foraminifera, can pay very much attention to the publications of the modern and fundamentally American school of commercial protozoology. It was a *dies nefas* for the biological student of the group when American systematists formulated the theory that minute variations of the ectoskeleton revealed the presence in oil shales, at a given depth, of petroleum, and that these variations progressively indicated where petroleum wells might be sunk. This formulation was made in, approximately, 1917, since when a vast body of workers, numbering more than three hundred, has been banded together, for the most part in somewhat quarrelsome mood, into the Society of Petroleum Geologists of America, with rival laboratories and a journal of its own.

Between the two chief workers in this economic

field, Dr. Galloway, the author of the work under review, and Dr. J. A. Cushman, of Sharon, Mass., there would appear to have been a race for publication, in which, on Dr. Galloway's showing, Dr. Cushman has twice been successful, anticipating many of the ideas which Dr. Galloway had discussed in detail with him.

In the present volume, Dr. Galloway gives a well-selected history of the classifications of the Foraminifera from the time when, in 1826, d'Orbigny put forward ten families and sixty-four genera, to the appearance, in 1884, of Brady's "Report on the Foraminifera of the *Challenger* Expedition", which became at once the standard classification of the group, with ten families, twenty-nine sub-families and one hundred and fifty-three genera, and which remains, in spite of latter-day criticism, the firm basis upon which zoologists have worked ever since. Brady made an *ex cathedra* statement, which it would be well for the modern student to bear in mind. He said: (*Challenger* Report 1884, p. 58) "The study of the Foraminifera, as assemblages of forms grouped round a comparatively small number of central or typical species, as advocated by Carpenter and his colleagues, is, I am convinced, the only means of arriving at a correct understanding of the biological relations of the Group." This point of view, if it was ever held by the American school, has been lost sight of in recent years, since the structure of the Foraminifera has become of commercial importance. Since the founding by Dr. Cushman in 1925 of his quarterly "Contributions to the Cushman Laboratory of Foraminiferal Research" (the ninth volume of which will be completed by the end of the year), the floodgates of nomenclature have been opened and into these fathomless receptacles the rising spate of new genera and species has escaped ever since.

In 1928, Dr. Cushman published a classification of the Foraminifera comprising 45 families, 68 sub-families and 413 genera, a classification modified in the second edition of his book (1933) into 47 families, 79 sub-families, 558 genera and 8 sub-genera, while in Dr. Galloway's present work, 35 families, 61 sub-families, and 542 genera are given. To establish these portentous figures, a vast number of papers have emanated from the American school and its Continental disciples. During the period 1930–1933, no less than 267 papers have been published to my present knowledge, and I am continually hearing of others hitherto unknown to me.

In a like period, 1929–1932 (the "Zoological Record" for 1933 not having yet been published), 66 new genera and sub-genera, and 1,301 new species of Foraminifera have been tabulated. Unfortunately, most of these new genera have been carved out of genera, already established by time and authority, where in my opinion they should have appropriately remained. Thus in an article in Dr. Cushman's "Contributions"*, he points out that as a result of his researches into European collections "new generic names are necessary for a number of species", and he carves out of *Clavulina* three new genera, *Martinotiella*, *Listerella* and *Goësella*; out of *Lituola*, *Liebusella*; out of *Gaudryina*, *Marssonella* and *Karreriella*; out of *Verneuilina*, *Eggerella*; out of *Nubecularia*, *Sinzowella*; out of *Planispirina*, *Wiesnerella*; out of *Pavonina*, *Ammospirata*, and so on.

It was said of d'Orbigny, the father of the study of Foraminifera, that "when anyone sent him new species, it was his custom to dedicate one of them to the sender. People were glad to see their names perpetuated by that of one of Nature's products, and there was mingled with this feeling of innocent vanity, the noble desire to contribute to the progress of science"†. Dr. Cushman would appear to carry this genial custom to an exaggerated point.

To come nearer home, my old friend Frederick Chapman‡ has made a genus *Heronallenia*, out of two species, the genotype being one named by Earland and myself, *Discorbina wilsoni*, other included species being *Discorbis kempii* (HA and E) and three others, concerning which genus we were constrained to make some critical remarks in Part I of the report on the Foraminifera of the *Discovery* Collections (1932, p. 419).

It has even happened that new species have been named from a full plate of a highly variable species by a later author, who had never seen the specimens figured therein.

No more convincing proof than this is needed to indicate that 'variation within a species' has 'gone by the board'. When in doubt whether a specimen conforms to a recognised figure, it is obviously a labour-saving practice to give it a new name, though it may not be in accordance with scientific method. When I was working in 1892–93 with F. W. Millett (the last of the great workers on the group) on Prof. A. C. Haddon's gatherings from the Torres Straits, I voiced a plaint

* Contributions to the Cushman Laboratory of Foraminiferal Research, vol. 9, pt. 2, p. 32.
† Gaudry, *Révue des Deux Mondes*, **19**, 831, 1859.
‡ Chapman and Parr, *Proc. Roy. Soc. Victoria*, **42**, Pt. 2, 1–14, 1931.

upon this subject. Millett replied in a characteristic letter, which I have published* elsewhere for the comfort and instruction of beginners, and from which I shall quote again. He wrote: "When I first started I thought I should find them [the Foraminifera] like a well-shuffled pack of cards . . . what I really found was this. Somebody had taken a hundred packs of cards and chopped each card into half a dozen pieces, then shaken the whole up in a bag and taking out at random half a dozen pieces at a time, had pasted them down on plain cards. . . . Then two or three packs of unmutilated cards stirred up in this medley would represent the typical specimens, the rest being intermediate varieties, the nearest affinities of which the student must judge for himself by experience."

In my opinion (and in that of many workers in many groups), the rigid international rules of zoological nomenclature should have been suspended (as provided for by No. 74 of the Summaries of Opinions), so that when hundreds of papers have made the generic names of species of world-wide distribution familiar to every student for a hundred years, one should not be compelled to register *Lenticulina* for *Cristellaria*, *Cibicides* for *Truncatulina*, *Elphidium* for *Polystomella*, *Camerina* for *Nummulites*, to name only a few examples.

"Taxonomy as applied to the Foraminifera" is the best and most significant chapter in Dr. Galloway's book, and one for which there is nothing but unqualified praise. In it he himself sets forth most cogent arguments against the manners and morals of the 'new school'. As he pertinently remarks: "The personal philosophy of the taxonomist has a very important bearing on his classification. . . . Different taxonomists place different importance on the same structures . . . some authorities allow great variation within a group, and others allow very little, the 'lumpers' and the 'splitters'. Fads, the particular biologic or paleontologic view-point of the moment also affect classifications".

Dr. Galloway's paragraphs upon "Comparative Morphology" and his "Philosophic Considerations" are admirable, and the same may be said for his section on "Evolution and its Corollaries", although his term "Bradygenesis" for an unusual retardation of ancestral stages in a test is, in this connexion, rather unfortunate. The introductory sections of this book are not only learned but deeply interesting and suggestive. The section on "Reproduction" alone is meagre and incomplete, probably because of the author's systematic view-point. In fact, it is when we reach his "Systematic descriptions" that we must meet him in the gate. To discuss the inclusion of many fresh-water and chitinous forms, and the validity of many of the 'new' genera, would lead us beyond the limits of a review, but I may be allowed to take exception to the classification of parasites infesting some species (especially *Saccamina sphaerica*) as Foraminifera — *Rhynchogromia*, *Ophiotuba*, *Dactylosaccus* and so on, taken from Rhumbler's paper of 1894.

The frontispiece is one of the highly idealised portraits of d'Orbigny, and comes from a work of great rarity, the title of which, as quoted on the frontispiece, contains a bad typographical error. The outline figures which fill the forty-two plates cannot but be of immense value to students of the group, but it is difficult to understand why the "magnification of the figures is not given; sizes of specimens are included in the generic descriptions", in the form "up to—mm.", an indication completely useless, for example, in *Miliolina*, *Orbitolites* or *Cycloclypeus*. A nine-page glossary with an ample index form a useful termination to the book.

EDWARD HERON-ALLEN.

* "Prolegomena towards the Study of the Chalk Foraminifera", etc., p. 21, 1894. London.

Radio Technique

(1) *Short Wave Wireless Communication.* By A. W. Ladner and C. R. Stoner. Second edition, revised and enlarged. Pp. xiv+384+13 plates. (London: Chapman and Hall, Ltd., 1934.) 15*s*. net.

(2) *Handbook of Technical Instruction for Wireless Telegraphists.* By H. M. Dowsett. Fifth edition, revised and enlarged. Pp. xix+572. (London: Iliffe and Sons, Ltd., 1934.) 15*s*. net.

(3) *Principles of Radio.* By Keith Henney. Second edition. Pp. xii+491. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 21*s*. 6*d*. net.

THE first and third of these books are second editions, the other is the fifth edition of that firmly established work which began as "Hawkhead", and later became "Hawkhead & Dowsett". All of them have thus had the benefit of friendly aid from reviewers, and are better books because of that aid.

(1) Messrs. Ladner and Stoner make handsome acknowledgment in their new preface, and their

second edition is a notable advance on a highly commended first. The points least favourably commented on have been corrected, and the new edition contains excellent fresh material which will maintain and enhance the reputation of this book as the only satisfactory work yet available on short-wave communications. The additional material on aerial arrays and feeders, and on ultra-short wave working, is specially welcome.

The recognition of frequency stability as the key to the future scope of ultra-short waves may be specially mentioned; the closely related subject of frequency stability in the main short-wave band occupies a whole chapter, which might have been improved by statements of attainable performance, as, for example, in the Franklin master oscillator. The same chapter refers the reader to "the articles dealing with" the multi-vibrator method, but does not tell him where they may be found. The chapter on the propagation of short wireless waves is good, but might be much better if it were freed from some needless obscurities of exposition. The suggestions that there are "no air currents" in the upper atmosphere, that "the actual composition of air is not of particular importance to wireless communications", that "the *E* layer reflects all waves longer than the (*sic*) critical wavelength", that the *E* layer is "ionised by some corpuscular bombardment", that Appleton first "postulated" the separate existence of the *F* region, which, in fact, he demonstrated, are all singularly dangerous fractions of truth. On the personal side, Lord Kelvin can doubtless spare some of the laurels which the authors arbitrarily transfer to T. L. Eckersley, but another distinguished Cambridge observer should not be misspelt to simulate a distinguished Observer in the rival township.

(2) The author of this always valuable handbook knows exactly what he wants to do, and does it exactly. His aim is "to provide simple instruction for sea-going operators and others . . . a complete theoretical course for the P.M.G. Certificate". He tells them as much as he thinks good for them, and no more. He scarcely ever says anything that can mislead them, and the result is a thoroughly satisfactory book of its very special kind. This fifth edition contains new material which shows how the demands on the sea-going operator increase—beyond, indeed, the limits of wireless telegraphy. "Constant Frequency Oscillators", "Short Wave Marine Transmission and Reception" and "Marine Telephony" follow directly in the original succession, but "Echo Sounding Apparatus" and "Band Repeaters" are added benefactions. The book is well known to be quite indispensable to sea-going operators; it remains only to say that the "others" are a very large class indeed.

(3) This is a much less satisfactory book, partly, no doubt, because its aim is much less definite, partly because the author frequently lapses into a carelessness which is not excused by the fact that "those skilled in the art" can see quire clearly that he "knows all about it", and could have avoided the setting of booby traps. He may be forgiven for vacillating about what electricity really is, but he should make up his mind to have one story and stick to it, especially after raising false hopes of meticulous treatment by telling us that "the resistance per foot may be obtained . . . by dividing the resistance per thousand feet by one thousand". Contrast this with the harrowing picture of the next page:—"Scientists have approached to within a fraction of a degree of absolute zero". Brrrr! There are much better books of the same general scope, and Mr. Henney could have written one of them.

Soil Science in Hungary

Általános talajtan. By Dr. Elek 'Sigmond. Pp. xii+696+5 plates. (Budapest: The Author, Keleti Károly-utca 24, 1934.) n.p.

BEFORE the War, Hungary was predominantly an agricultural country with a girdle of forests; she possessed but few urban industries. The great consuming centres of Hungarian products were in Austria and in Bohemia, and for that reason Hungary was known as the granary of the Austrian Empire. In spite of efforts directed towards the attainment of self-sufficiency in manufactured products, Hungary now finds herself forced to rely more than ever upon cultivated products of her soil: even the forests lie largely outside political Hungary of to-day. Hungary's ability to weather the conditions imposed upon her has been due in no small measure to the excellence of her agricultural research and teaching.

It may seem, superficially, to be a curiosity that Hungary should have two experimental stations for the study of paprika, but in fact, every aspect of Hungarian agriculture is catered for by the agricultural research and experimental stations. Six soil laboratories have recently been

established at the instigation of Prof. Elek (Alexius) 'Sigmond. The largest of these is attached to the Central Chemical Institute in Budapest, of which institute Prof. 'Sigmond is director.

It is remarkable that within such a comparatively small language group as is the Hungarian, a demand for a textbook on soil science should have led to the publication of the compendious work under review. Only one similar—but smaller—book has been published in Great Britain. *Általános talajtan* (freely, "The Comprehensive Study of Soil") is purely a pedological treatise; it devotes only seven pages to the soil as a medium for plant growth, whereas twenty pages are occupied with consideration of the rôle of plants in soil formation. These statements briefly give the key to the book's character.

The work is divided into four sections covering formation and genetics, properties, classification, and mapping of soils. The last two will need little introduction to those who are aware of the prominent part played by Prof. 'Sigmond in elucidating the constitution of soils, especially of 'alkali' soils. The treatment is excellent, and the folding coloured plate showing typical profiles with the appropriate vegetation, beautiful.

The section on the properties of soil has been contributed in part by colleagues, with varying success. Prof. 'Sigmond has written about inorganic constituents, and Dr. Kotzmann has added a distinctive monograph on organic matter in soil. Unfortunately, the treatment of physical properties is far from up to date. Dr. Telegdy Kováts contributes a condensed but knowledgable survey of soil microfauna, while the lesser microbiological life is dealt with by another author without much attempt at correlation, so that little of real value emerges from it.

In the section dealing with the formation of soil, Prof. 'Sigmond is thoroughly at home; he has made an extensive review of all possible factors, from the geological to the human. A number of minor errors disfigure the book, otherwise well printed and produced. These will be readily forgiven, since the author was a sick man when he was completing the work, and indeed his book is prefaced with a grace that he was spared to finish it.

Prof. 'Sigmond has now held the first Hungarian chair of agricultural chemistry for twenty-five years; during that time he has done very valuable work. Closely linked with Prof. 'Sigmond's name, soil science in Hungary is having attention paid to it to an extent relatively greater than in some other and richer countries. It was largely owing to methods devised by the author of this book that the reclamation of alkali soils in Hungary has been so brilliantly successful. The actual supervision of that reclamation devolved chiefly upon his pupils at one or other of the soil institutes. For them, and for those who will follow them, this textbook is intended. Hungary is fortunate in possessing such a standard of scientific and technical attainment as that to which the book stands witness.

H. N.

The Rhesus Monkey

The Anatomy of the Rhesus Monkey (Macaca mulatta). By T. H. Bast, Kermit Christensen, Harold Cummins, Frederick D. Geist, Carl G. Hartman, Marion Hines, A. Brazier Howell, Ernst Huber, Albert Kuntz, S. L. Leonard, P. Lineback, John A. Marshall, Gerrit S. Miller, Jr., Ruth A. Miller, Adolph H. Schultz, T. D. Stewart, William L. Straus, Jr., W. E. Sullivan, Geo. B. Wislocki. Edited by Carl G. Hartman and William L. Straus, Jr. Pp. ix+383+7 plates. (London: Baillière, Tindall and Cox, 1933.) 27*s*.

WHAT was a very evident gap in the literature on Primates has recently been filled by the publication of the volume under notice on the structure of the rhesus macaque, the commonest of laboratory and menagerie monkeys. Up to the present, there have been no more than two readily available books to which English students could refer for information about the anatomy of monkeys and apes—Duckworth's "Morphology and Anthropology", originally published in 1904, and Sonntag's "The Morphology and Evolution of Apes and Man", published in 1924. Neither of these two provides as much detailed information about subhuman primate anatomy as does the new volume on the rhesus.

The book, which has been edited by Drs. C. G. Hartman and W. L. Straus, is divided into sections, each the work of some one or more authors familiar with that particular field. It opens with a short taxonomic note by Gerrit S. Miller, Jr., and this is followed by an account of the animal's growth and development. This section, the work of Dr. Adolph Schultz, is in many ways one of the more interesting and valuable parts of the book. The skin, the skeleton and joints, the muscular system,

the nose and throat, the viscera, as well as all the other bodily systems are then each treated separately, and the volume closes with an appendix by Dr. Hartman on the housing and care of the rhesus monkey.

In their preface, the editors apologise for a certain lack "of that balance that should characterise a text book". This lack of balance could scarcely be described as inconspicuous, and it will undoubtedly strike both of the classes, research workers and students of comparative anatomy, for whom this handbook should have a special appeal. Thus readers will wonder at the brevity of some sections—for example, that on the central nervous system—and in doing so they will almost certainly fail to find a point of view which justifies the devotion of nearly a third of the book to a description of muscles, especially when this appears to have been done at the expense of other parts. Because of its lack of balance, the book may unfortunately defeat one of the purposes of its publication, for the small amount of information given about such parts of the body as the nervous system and the vascular system, will diminish its value to many experimental workers.

There are other criticisms which will undoubtedly be made by specialists who go to the book for information about the rhesus. For example, there can be few experimental biologists who do not already know from their most elementary studies of zoology and mammalian anatomy, such simple facts as "the eye-ball consists of three coats", or that muscles are usually "grouped in the categories, unstriated, cardiac and striated". There are many more specific pieces of descriptive information about the rhesus that could have been related rather than including description which applies fairly generally in mammalian anatomy. For example, the intimate structure of the retina could have been discussed, or if not discussed, at least reference could have been made to the literature where it has been discussed. It is true that in their preface the editors point out that the bibliographies of the separate chapters include only the more important references, but even this apology does not excuse the lack of mention of such outstanding works as, to cite another field of study, Poljak's recent monograph on the rhesus brain.

In spite of shortcomings such as these, the book, which is well illustrated and indexed, performs a useful and stimulating service. It not only describes the rhesus, but it also affords an excellent background for further anatomical studies of subhuman Primates.

Short Reviews

An Introduction to the Biochemistry of Nitrogen Conservation. By Dr. Gilbert J. Fowler. Pp. viii+280. (London: Edward Arnold and Co., 1934.) 12*s*. 6*d*. net.

SEVERAL years ago Dr. Fowler wrote a small book on some aspects of biochemistry of interest to civil engineers, medical officers of health and those engaged in tropical agriculture. The present volume is based on the earlier publication and includes the substances of lectures delivered at Patna University. Following a chapter on elementary biochemical technique, the author deals with the problem of nitrogen conservation with which he has been so closely identified in England and in India. The greater part of the book is new—the activated sludge process of sewage purifications developed by the author and his associates at Manchester was still unknown in 1911. This process is the greatest advance in general methods of sewage disposal which the twentieth century has yet produced.

From the time of Liebig, many writers have deplored the waste of fertilising material involved in the disposal of refuse from urban communities, without much practical result in Europe and America. The greater economic stress of life in the East has, however, compelled attention to the problem. In India the production of compost from vegetable waste treated with cattle urine, as at Indore, or with activated sludge, is now well organised. An attempt is made to control the carbon-nitrogen ratio on the lines first established at Rothamsted.

Considering the range of subjects covered, the bibliography is comprehensive. The chapter on non-nitrogenous organic matter contains no reference to Norman's work on the biological decomposition of plant materials, a subject fundamental to many of the operations described later. It is a pity that the references were not checked more carefully, as a few errors or misprints in the earlier publication have been reproduced. The style is easy, and the book cannot fail to interest students of hygiene and agricultural science. E. H. R.

Geology of California. By Ralph D. Reed. Pp. xxiv+355+17 plates. (Tulsa, Okla.: American Association of Petroleum Geologists; London: Thomas Murby and Co., 1933.) 5 dollars.

FOLLOWING the earlier studies of the igneous and metamorphic rocks of the mining districts of California, there has more recently been an

immense amount of detailed and accurate work devoted to stratigraphical geology and palæontology by the geologists of large oil companies. As a result, much information, widely scattered in the literature and in private reports, is available for an adequate interpretation of the larger problems of regional and historical geology. Synthesis has lagged behind, and the author of this admirable book has rendered valuable service not only to the geologists of the State, but also to a wider circle, by furnishing a simple, well written and beautifully illustrated account of the present status of geological investigation in California.

The first four chapters deal with geological provinces, structural problems, and pre-Mesozoic and Triassic rocks, and chapters are then devoted to each of the succeeding systems in turn, post-Jurassic events receiving most attention. As chief geologist to an important oil company, the author writes with particular authority on the Miocene beds and the diastrophism which they reveal. The book should have a special value in stimulating research, since it directs attention to the many complex problems that remain to be solved before the full history of the coast ranges and other parts of California can be written.

In addition to a detailed index of authors and subjects, there is a useful appendix of geographical names and a locality index map; this feature might well be adopted in all similar works since it saves the unfamiliar reader much mental friction. The illustrations effectively portray a wide range of phenomena.

On a New Chemical Theory and Researches on Salicylic Acid. Papers by Archibald Scott Couper (1858). (Alembic Club Reprints, No. 21.) Pp. 45. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson, 1933.) 2*s*. 6*d*.

THE latest of the Alembic Club reprints gives us the papers of Archibald Scott Couper who, as is now recognised, shares equally with Kekulé the credit for enunciating the theoretical conception of the linking of carbon atoms in the molecules of organic compounds. Few conceptions have been more fruitful of results or had greater influence on the development of chemistry, and it is most desirable that the part played by Couper should be established beyond doubt. The studies of Anschütz published in 1909 have done much to make clear his achievements, showing in particular that there was a delay in the presentation of his first paper to the Paris Academy owing to the dilatory action of Wurtz. Following the sympathetic biography of Anschütz, the Scottish chemists combined in 1931 to place a memorial plaque at Townhead, Kirkintilloch, where Couper was born in 1831, the full circumstances being placed on record in the *Journal of the Society of Chemical Industry*, vol. 50.

The present reprint gives the short note on "A New Chemical Theory" presented to the Academy by M. Dumas, and the full English paper supplemented by certain additions from the later French version. Both the French and English versions of the paper "Researches on Salicylic Acid" are given, the former being apparently the earlier, as Couper made the change from C=6 to C=12 between their respective dates of publication.

No student of organic chemistry should fail to read these papers.

An Introduction to Thermodynamics for Chemists. By Dr. D. Johnston Martin. Pp. vii+343. (London: Edward Arnold and Co., 1933.) 16*s*. net.

THE object of the author of this textbook is to provide a work of a less advanced and detailed nature than the classic volume of Lewis and Randall, and at the same time to clarify certain fundamental principles with the view of making the subject one of real utility to the practical chemist. Thus, since most measurements refer to reactions at constant pressure, the advantage is urged of employing the criterion of zero free energy change at constant temperature, instead of zero maximum work of a process at constant volume and temperature, since the former is true of any reaction whatsoever.

A clear differentiation between free energy and maximum work is emphasised, and special attention is given to a proper appreciation of the concept of entropy. The rest of the text, apart from developing the laws of thermodynamics, deals with the application of thermodynamic principles to continuity of state, homogeneous systems, dilute solutions, electrochemistry of dilute solutions, the activity treatment of solutions, strong electrolytes, chemical affinity and heterogeneous systems. All these are well illustrated by tabulated data for an extensive range of substances and reactions.

The book should fill the needs of a wide circle of students and investigators; no advanced mathematics is introduced, printing and production are of a high order, and there is a really efficient author and subject index. N. M. B.

Commonwealth Bureau of Census and Statistics, Canberra. *Official Year Book of the Commonwealth of Australia.* No. 26, 1933. Prepared by E. T. McPhee. Pp. xxxii+942. (Canberra: Government Printer, 1934.) 5*s*.

THIS useful year-book may almost be regarded as a model of arrangement and condensation. The need for economy still restricts its growth and precludes the inclusion of the special articles for which earlier issues were noted. The essential statistical matter, however, has not suffered curtailment. A special index refers to longer articles in former issues. In this issue the vital statistics of the 1933 census have been included and analysed. Agricultural, pastoral and mining activities are fully treated and made more valuable by the inclusion of many comparative statistics for other countries. Full attention is paid to labour, wages and public finance, while an appendix gives the history of the financial crisis in Australia. A list of useful books on Australia is added.

Gyromagnetic Measurements and their Significance

By Dr. L. F. Bates, University College, London

THERE have recently appeared a number of articles in foreign periodicals, and of footnotes in treatises on magnetism concerning gyromagnetic measurements, which, perhaps unintentionally, show three main tendencies. First, they tend to obscure the fact that credit is certainly due to O. W. Richardson, who was the first to show that, if the electron is responsible for ferromagnetism, then it ought to be possible to make quantitative measurements in gyromagnetism. Secondly, they tend to disregard much of the earlier work on the subject, to view certain results as merely approximate and to neglect much of the latest work on the subject. Thirdly, they suggest that important sources of error were entirely overlooked by some workers. Consequently, it seems desirable to examine the present position so far as is possible in a short article.

In practice it is necessary to consider only two gyromagnetic effects. One such effect is produced when we take a cylinder of any substance and rotate it rapidly about its long axis; on account of the Larmor precession of the electrons, the cylinder becomes magnetised parallel to the axis of rotation. Actually, such magnetisations have been measured so far only in the case of ferromagnetic substances. Many experiments on this effect have been successfully made by Barnett in the United States since 1914. It is sometimes suggested that this effect is not strictly the converse of the other effect, with which the above publications are almost exclusively concerned. It will not be considered further here, although Barnett's results agree as well as can be expected with others described below.

The other effect may be described as the production of angular momentum by change in magnetisation. Richardson showed in 1908, as mentioned above, that if the magnetic moment of a freely suspended body be changed by an amount M, then the angular momentum about the same direction should be changed by an amount U, the ratio U/M, the gyromagnetic ratio, being equal to $2m/e$, on the assumption that the electron is a point charge moving in a closed orbit.

It was not until 1915 that the effect was even experimentally detected by Einstein and de Haas, and, consequently, on the Continent the effect is known as the Einstein-de Haas effect. Incidentally, when two English workers termed it the Richardson effect in a well-meant effort to credit Richardson with its prediction, Sir Oliver Lodge, in the course of a lecture, part of which was published as a supplement to NATURE of August 4, 1923, strongly deprecated the attachment of personal names to such effects. Einstein and de Haas stated that they found exact agreement between experiment and the theory, which they had independently re-discovered. Such agreement was not confirmed by later workers, for in 1918, J. Q. Stewart found the ratio for iron to be $0 \cdot 98\, m/e \pm 15$ per cent by a direct method, and in 1919 Beck found $1 \cdot 06\ m/e \pm 5$ per cent and Arvidsson $0 \cdot 94\ m/e \pm 4$ per cent by resonance methods.

At this stage the problem was attempted by Chattock and Bates, who used the direct method of observation. They suspended a thin iron or nickel wire from a fine quartz fibre so that its axis coincided with that of a vertical solenoid, and measured the angular momentum produced on reversing the magnetisation of the wire, by the deflection of the wire against the torsion of the fibre. The ratio was thus found to be exactly equal to m/e within the limits of experimental error, which were considered to be about 1 per cent. It was not thought necessary to neutralise the vertical component of the earth's magnetic field in these experiments, and this has been a source of criticism. Such criticism, however, takes no account of the fact that Chattock and Bates proved that U is strictly proportional to M for a wide range of values, which would have been impossible if the unneutralised component had produced a serious source of error. Since magnetostriction and electron inertia effects loom large in criticisms of later work, it is as well to state here that they could not have been sources of error in these direct experiments.

This result was confirmed by Sucksmith and Bates in 1923, using a null method of measurement designed by Chattock, with an error of about 1 per cent. Now, measurements more recently made by Barnett by a very similar method, in which lower magnetising fields and lower frequencies were employed, gave the values $1 \cdot 04\ m/e$ and $1 \cdot 05\ m/e \pm 0 \cdot 5$ per cent for iron and permalloy, and $1 \cdot 06\ m/e$ and $1 \cdot 08\ m/e$ for nickel and cobalt, respectively. It has been suggested that the differences between Barnett's results and those of Sucksmith and Bates arise because the latter did not attempt to neutralise the vertical component of the earth's field, or to eliminate the effects of magnetostriction and inequalities in the half cycles of the alternating current supplied to the magnetising solenoid. Against this suggestion, however, it must be stated that if such serious errors existed in their work, it is very surprising that of the thirty-eight results recorded for iron, nickel and Heusler alloy by Sucksmith and Bates, not one exceeds the value $1 \cdot 03\ m/e$.

Other workers, presumably aware of the discrepancy, have recently provided independent support for the value m/e, but their results have not received the attention they deserve. Thus Coeterier and Scherrer[1] give a provisional value of $0 \cdot 995\ m/e$ for iron, whilst in his 1933 Amsterdam thesis, Coeterier gives the final value $1 \cdot 01\ m/e$ for

iron in powder form. These values were obtained by a resonance method in which a special photo-electric relay reversed the direction of the magnetising field as the oscillating system passed through its zero position.

Again, Ray-Chaudhuri[2] has published the values 1·008, 1·016 and 1·022 m/e for Fe_3O_4, Fe_2O_3 and $NiO \cdot Fe_2O_3$, respectively, with a possible error of 2 per cent. These substances were used in powder form packed inside thin glass tubes. A resonance method with an apparatus similar to that used by Sucksmith in his measurements with paramagnetic substances was employed, the apparatus being evacuated to give large resonance oscillations.

It is, however, desirable to consider the theoretical grounds on which the ratio may conceivably be greater than m/e. For any electron system, the ratio is accurately given by the expression $\frac{1}{g} . 2 . \frac{m}{e}$, where g is the Landé splitting factor, which is equal to 1 for purely orbital motion and equal to 2 for spin motion alone. If ferromagnetism is due entirely to electron spin, then the ratio must be m/e, but if due to an electron system which is distorted by the fields of neighbouring atoms, it is suggested that g may lie between 1 and 2, the ratio being correspondingly increased. Again, van Vleck has suggested that two types of ion with g values of 3/2 and 2 may be simultaneously present in the iron lattice and thus give an effective value of g less than 2.

A measurement of great interest in this connexion is that of Coeterier on pyrrhotite, which shows well-known ferromagnetic peculiarities; this substance in powder form gave a value of 0·63 for g by the method outlined above. Inglis has shown, on the basis of a simple model in which the orbital momenta of the effective electrons are orientated antiparallel to their spins, that the theoretical value for g is 2/3. It is, perhaps, noteworthy that the experimental value of the ratio is thus somewhat higher than the theoretical value, so that perhaps Coeterier's value for iron is also a little too high, but incomplete orientation, as suggested by Inglis, would also account for this difference.

In the case of simple paramagnetic compounds of the rare earth and iron groups, we have fairly definite knowledge of the g values for the appropriate ions based on spectroscopic data. The direct determination of the gyromagnetic ratio for such substances is a matter of extreme difficulty, but such measurements have been successfully made by Sucksmith, who finds satisfactory agreement between the calculated and experimental values. The limits of experimental error were about 6 per cent, but, in view of the great experimental difficulties, Sucksmith was fortunate to get measurements at all. Therefore, the suggestion in a recent article by Barnett[3] that even these most skilful measurements are open to the serious errors supposed peculiar to English work on gyromagnetism is a little difficult to understand.

In conclusion, then, there appears to be no valid reason why theoretical physicists should consider the gyromagnetic ratio for simple ferromagnetic substances, and for simple paramagnetic substances, to be other than m/e and $\frac{1}{g}$ 2 m/e, respectively, in the present state of our knowledge.

[1] *Helvetica Physica Acta*, 1932.
[2] NATURE, **130**, 891, Dec. 10, 1932.
[3] *Phys. Z.*, March 1, 1934.

Research in Australia and New Zealand

WHEN the prices of wheat and wool fell calamitously four years ago, Australia found herself on the verge of economic collapse, and every State department was compelled to tighten its belt in order to avert a general disaster. Among them, the Commonwealth Council for Scientific and Industrial Research discovered some economic truths for which it had not been consciously seeking, and it is now both suffering from, and benefiting by, its discoveries*. It is an undoubted fact that under boom conditions, research is liable to become far more costly than it need be; a successful investigation may well yield a continuous profit of 1,000 per cent or more on the original capital outlay, and rapidly lead to the initiation of a host of superfluous and hopeless projects. These are the first to be weeded out when contributions to research are curtailed. The Australian Research Council deserves sympathy for the enforced curtailment of its activities, but congratulation for making immediate use of adversity by pressing forward existing schemes for inter-State co-ordination and imperial co-operation in agricultural research. Proposals for establishing a Commonwealth organisation in agricultural and pastoral research were put forward seven years ago, but in view of the wide divergence of interests between the different States and the great distances separating the chief research institutions, it is doubtful how far those proposals would have materialised in the absence of the pressure exerted by recent economic events. In making grateful acknowledgment of the assistance of the now defunct Empire Marketing Board, the Council emphasises the inestimable services performed by the Board in bringing research institutions in different parts of the Empire into close touch with one another.

The report of the Council for the past year, although not recording any outstanding new results of research, gives some very striking figures illustrating the cash returns that have been, and

* Seventh Annual Report of the Council for Scientific and Industrial Research for the year ended 30th June. (Canberra: Commonwealth Government Printer, 1933.) 3*s*. 8*d*.

may be obtained from the application of scientific research to agriculture in Australia. Thus the complete solution of the problem of 'bitter pit' in apples—a disease found to be associated with immaturity at picking time—has resulted in a saving of £100,000 per annum to the Australian export trade. Root rots and smut of wheat cause losses of more than £1,000,000 a year, and already considerable progress has been made in controlling these diseases. Great strides have in the past been made in the field of plant breeding, and have enabled Australia to become one of the chief wheat producing countries of the world, and it is pointed out that further work which might result in an average increase in quality equal to a penny a bushel would now bring an annual return of £1,000,000. Even at the present low price of wheat, an increased yield of a bushel an acre would mean more than £3,000,000 added to the value of the Australian crop. It is true that many of these savings have yet to be made, but it is already obvious that the Council is paying very satisfactory dividends on its annual expenditure of about £100,000.

Australia's greatest problem is the shortage of water, which limits the natural expansion of both her great industries—wheat and wool production. Progress in the past has depended on the conquest of drought; plant breeding has enabled farmers to produce a bushel instead of half a bushel of wheat for every inch of rain, and animal breeding has enormously increased the yield of wool per sheep from the specially bred merino strains. Progress in the immediate future will involve the consolidation of the position already won, by improving the quality and hardiness of drought-resistant wheats and by maintaining, on dry pasture lands often of indifferent quality, the high wool yield of which the modern merino is capable.

This presents problems of great interest. Apart from the question of drought, there is the greater demand made on soil minerals to produce increasing quantities of wool, and areas once regarded as fertile are incapable of producing the maximum yields that are now possible, and economically essential. In particular, the question of the sulphur metabolism of sheep has come into prominence. Wool consists of keratin, which contains a high proportion of sulphur, and it has so far been assumed that the sulphur needed for the growth of wool must be supplied as cystine. Since the amount of cystine produced by pastures is limited, investigations have been made on the effects on wool production of adding sulphur in other forms to the diet, but without any significant result. The importance of the problem, however, is apparent, and emphasises the imperative need of co-ordinating research on animal breeding and nutrition. It is useless to breed for still higher yields of wool, if the sheep cannot procure the necessary materials for making the wool.

Drought is also being combated by large-scale irrigation schemes, of which the Murray River scheme is perhaps the best known. Its object is to develop a dried fruit industry and involves problems of adjusting a human community to a new environment besides those bearing on irrigation engineering and costs, soil properties, fruit culture and processing, and the control of old and new pests. From its comprehensive nature, the work can only yield results gradually, but it deserves special notice as illustrative of the modern trend of agricultural research programmes —to consider each problem in its intimate relation to all others, biological, chemical, economic and social.

Australian research, under the influence of the slump, is recovering from the first flush of its early triumphs, and one can read between the lines of the Council's report the unexpressed conviction that future progress, although certain, will demand patience, and the realisation by all concerned that the science of the land is one the secrets of which are too deep and complex to be solved except by the corporate action of its many branches.

A striking feature of the work of the New Zealand Department of Scientific and Industrial Research* is that much of it is directed towards the more efficient application of science as a weapon in the struggle to preserve a distant market. As might be expected, most of its activities are connected with agriculture, and one of its first tasks is to keep constantly informed of the changing food fashions of industrial England. The Department works in close co-operation with research organisations such as the Low Temperature Research Station, the Imperial Mycological Institute and the Imperial Agricultural Bureaux in England, and several of its branches maintain liaison officers in London to advise and to secure expert opinion on new lines of produce shipped from the Dominion. Reports received from Britain often determine the lines of research followed in New Zealand.

For example, it was learnt—what is perhaps not realised in Britain itself—that people here are showing an increasing preference for butter with a distinct lactic flavour, and consequently the attention of the Dairy Research Institute was directed towards discovering how this flavour can be obtained—not so much in fresh butter as in butter that has travelled for six weeks in cold storage. The investigation has shown that the required flavour can be obtained by using the highest quality cream. It is interesting to read that "overseas buyers showed themselves remarkably sensitive to salt. . . . It is well known that certain districts in Britain vary in their preferences for degree of saltiness in butter, hence it is incumbent on local buttermakers to study the needs of their special markets before adding salt". We wonder if the British farmer is advised to study the respective idiosyncrasies of London and

* N.Z. Department of Scientific and Industrial Research. Seventh Annual Report for the year 1932–33. (Wellington: Government Printer, 1933.) 2s. 6d.

Manchester with the same care as the New Zealander!

Again with an eye to the British market, a considerable amount of new work has been carried out on the refrigerated transport of fruit, and it has now been found possible to deliver New Zealand plums in London in excellent condition; attempts to transport lettuces, tomatoes and passion-fruit, however, have been unsuccessful. An investigation which showed that two varieties of apple—Cox's Orange and Jonathan—travel much better at a carrying temperature of 2° F. above that hitherto used (33°–35°) indicates the enormous scope for detailed research that still remains in the realm of cold storage. It is stated that the present inadequate understanding of the meaning of maturity is one of the greatest obstacles to the progress of refrigerated fruit transport.

In 1932, New Zealand exported about 12,000,000 pickled pelts—an important by-product of the frozen meat industry. The pelt market is very difficult to accommodate, as different buyers have very different views on what are the most desirable qualities in pelts. Since it is impossible to manufacture economically and at the same time satisfy every buyer, research has been directed along the eminently practical lines of making experimental shipments of pelts and discovering their relative values through reports prepared by the New Zealand Pelt Committee in London. Such research is bound to be costly, but it affords a good illustration of the direct way in which New Zealand is attacking practical problems with the closest co-operation between the buying and selling sides of industry. The programme of the Leather Research Association is largely based on the reports received from the Committee in London.

Active research, in collaboration with the English parasite farm at Farnham Royal, and with the help of the Empire Marketing Board, has been carried out on the elimination of noxious weeds. Particular attention has been paid to the ragwort seed-fly and to the piripiri saw-fly, and the value of both parasites—especially the former—in checking the spread of the weeds has been established. The gorse-seed weevil has been effective in the south only, as the flowering season of gorse in the north does not coincide with the weevil's period of activity. The use of the Buprestid beetle against blackberry has had to be abandoned, as it was beginning to attack apple trees, while the blackberries sometimes survived. New Zealand is thus discovering both the possibilities and pitfalls of this modern method of biological control.

The unglamorous but, for the future of agriculture, fundamentally important task of soil survey is continually being extended. In recent years much valuable information has been obtained on the cause and cure of bush-sickness, a disease closely related to the soil type of the pastures grazed by affected animals. The interesting fact has emerged that this iron-deficiency disease is caused by a lack of available iron in the soil itself, rather than in the vegetation, the animals obtaining an essential part of their iron by ingesting soil along with the grass. The diseases can be controlled by giving limonite licks, but the most complete cure has been obtained with drenches prepared from the soil of a healthy pasture, suggesting that iron deficiency is not the only cause of the ailment. Other cattle ailments have been traced to deficiencies in pastures of magnesium, iodine, calcium and phosphorus.

The work of the Department covers other branches of agriculture, concerned mainly with export produce, as well as geological survey, meteorology and astronomy. In a world abounding in international obstacles to the spread of applied science, it is satisfactory to find that New Zealand and Great Britain at least are co-operating freely to secure the widest application of the results of research to problems affecting the welfare of both. The achievement of that co-operation is perhaps the greatest of the Department's successes.

G. V. JACKS.

Scientific Aspects of Cooking

ANALYSES of even common foodstuffs are frequently incomplete, especially in the case of the mineral constituents. Moreover, most of the existing figures refer to uncooked food, although there are practical reasons why most diets can only be weighed or measured after the food has been prepared and cooked. It was with the object of bridging this gap that McCance and Shipp undertook a systematic analysis of cooked flesh foods; the results of their study have recently been published.*

A comprehensive analytical scheme was worked out for total, purine, non-protein and extractive nitrogen, fat, carbohydrate, chloride, total and inorganic phosphorus, sodium, potassium, calcium, magnesium and iron. The chief error was found to lie in the variations of composition of different samples of the same foodstuff: errors of sampling and fortuitous analytical errors were only small. Hence several specimens of each food were analysed whenever possible, but the analyses were not carried out in duplicate. The methods used are described in detail in the report and the analytical figures obtained are set forth in a series of tables and comprise the results of the analyses of 64 samples of fresh fish, 8 of preserved fish, 11 of shellfish, 20 of fresh meat, 8 of preserved meats, 11 of poultry and game, 12 of different animal organs and a few of raw foods. Each figure represents the

* Medical Research Council. Special Report Series, No. 187: The Chemistry of Flesh Foods and their Losses on Cooking. By R. A. McCance and H. L. Shipp. (London: H.M. Stationery Office, 1933.) 2s. 6d. net.

mean of at least two analyses, which were generally made on a mixed sample consisting of several specimens.

Only a few points can be referred to here. In the analytical procedures it is of interest to note that the authors used bromine to deproteinise their aqueous extracts. Examination of the figures obtained showed that the percentage deviation from the mean in the case of protein was 6–10, in the case of fat 30–45 and in the case of the salts 7–20. The dangerous errors in working with food tables, however, are first the systematic analytical ones and secondly the use of inappropriate tables, for example, those showing raw composition when the food is actually eaten cooked.

All the fish commonly eaten in Great Britain have been analysed: it was found that the white fish have on the whole a uniform composition. The purine content of whitebait was found to be high and only surpassed by that of soft roes and sweet-breads. Smelts, herring and whiting are also rich in purines. Sprats, sardines and whitebait may be a valuable source of calcium, since the bones are small and usually eaten. The winkle is peculiar in containing a very large amount of magnesium. The phosphorus content of foodstuffs depends largely on the amount of edible bone or nuclear material present.

The third section of the report is devoted to an experimental study of the losses brought about by cooking: the losses were determined at intervals after the beginning of cooking, so that the results can be expressed simply in graphical form. Beef and fish were chiefly studied, but there is no reason to suppose that other meats will behave differently. It was found that beef, when fully cooked, loses the same amount of weight, water and salts, whether the cooking is commenced in hot or cold water. When the temperature is raised to 60° C. all flesh foods shrink, owing to shrinkage of their proteins and the expression of juices. This is the only cause of salt loss when meat is heated in steam or air; in water, some salts are also lost by diffusion into the water. The extent of the shrinkage of beef, fish, kidney and liver proteins is little affected by raising the temperature from 80° to 100° C., but is slightly increased by a further rise to 120° C. Brain does not shrink below 80° C.; tripe shrinks when the temperature is raised from 80° to 100° C. Fish muscle loses weight in watery solutions below about *p*H 5·6 and gains weight at higher *p*H. Beef tends to gain weight at all *p*H values, especially below 4·5 and above 6·5. Acids and alkalis inhibit the heat shrinkage of muscle proteins. In fish, shrinkage is greatest at *p*H 4·0–4·5 at which loss of weight on soaking is greatest; in meat, shrinkage is greatest at about *p*H 6·0. It is suggested that the chief protein in fish has a more acid isoelectric point than that of beef. Shrinkage on heating is not so rapid nor so extreme just after death as it is 40 hours later. In heating by steam, 50 per cent of the water and salts of beef may be lost and a still higher percentage in kidneys. On lowering the *p*H of the cooking medium, meat and fish tend to lose more of their cations and less of their anions; fish juices are more alkaline than those of beef, and fish lose relatively more of their anions than meat on cooking in water.

In roasting, the loss of water is nearly all due to evaporation; the loss of salts is small, because when the juices are expressed and the water evaporated, the salts are left on the surface. Frying in deep fat leads to such rapid evaporation of water that the loss of salts is at a minimum. Loss of fat is due to liquefaction of the fat by the heat so that it runs off the meat; shrinkage of the proteins has little influence on the loss of fat.

The authors' experiments have led them to conclude that 'pressure cooking' has no advantage over steaming at 100° C., however economical it may be in time and fuel. Compared with heating in water, both methods have the advantage that all loss due to leaching out of soluble constituents is avoided. Salt losses in fish are greatly reduced by steaming, but with larger pieces of meat the losses are similar whether the meat is cooked in water or steam. No evidence was found that a pellicle forms on the outside of a joint when cooking is commenced at a high temperature; this procedure can only be supported on grounds of palatability or digestibility. Undercooked meat is probably not more nutritious than overcooked meat; in any event the latter is a more concentrated food, since the greater part of the weight lost in cooking is water.

News and Views

The Lost Fragrance of Musk

THE total disappearance within recent years of the scent of musk, *Mimulus moschatus* Dougl., is one of the most puzzling of plant phenomena. A native of North America, it was introduced into Great Britain from British Columbia in 1826 by the botanist David Douglas. It quickly became a garden favourite, and the yellow, rather insignificant flowers are still a familiar sight in cottage windows. The plant has become naturalised in certain parts of the British Isles and in New Zealand, where it was taken by the early settlers. At the beginning of the present century, the sweet-smelling musk was hawked from door to door in London suburbs. So far as records are available, it appears that the loss of fragrance was first noticed in Britain in 1909, when a well-known nurseryman asked: "Is there such a thing now as a common Musk with the old Musk perfume? Many friends of mine contend that there is not, and I myself am sceptical." Vilmorin, however, in "Les Plantes de Pleine Terre" (fifth edition, 1909), describes the musk as a "petite plante poilue et visqueuse, exhalant une forte odeur musquée, qui se sent à une grande distance", which suggests that

the 'mutation' had not been noticed in France at that date, and there is evidence that in some localities the failure to produce the characteristic perfume was not generally apparent until after 1916.

DURING the years that followed, it was believed that this failure to produce the 'musk' smell might be ascribed to some adverse condition of cultivation, and it was not known how world-wide was the phenomenon until Sir Arthur Hill, director of the Royal Botanic Gardens, Kew, in his presidential address before Section K (Botany) of the British Association in 1930 at Bristol, stated that, as a result of exhaustive inquiries in Great Britain and in western North America, it had been established that plants of musk with the old-fashioned and distinct fragrance were no longer to be found, even in their native habitat. Correspondence with New Zealand shows that the same thing has happened in all the stations where the plant was previously known to have been scented. Periodically reports reach Kew that the old scented musk has been rediscovered; unfortunately, the statements cannot be substantiated, and seeds submitted produce scentless plants or fail to germinate. Many ingenious suggestions have been made to account for the disappearance of the odour of *Mimulus moschatus* Dougl., but, so far, no conclusive theory has been offered.

Cancer Research

THE eleventh annual report of the British Empire Cancer Campaign, presented at the annual general meeting on July 9, contains summaries of a great variety of researches of different kinds, carried on in a number of laboratories and hospitals. Two of them are of particularly general interest. At the Middlesex Hospital, Prof. J. McIntosh has shown that tumours produced in fowls by the action of tar may be filtrable, that is, they may be transmitted from bird to bird by an ultramicroscopic agent which has many of the characters of a virus. In this way, the artificial tumours resemble those which spontaneously occur in birds, and filtrability seems to be a general property of bird tumours, irrespective of their mode of origin. The common-sense interpretation of this is that the virus-like agent arises in the tumour and does not come into the body from outside. At the Cancer Hospital, Prof. E. L. Kennaway, Dr. J. W. Cook and their colleagues have carried their brilliant work on carcinogenic chemicals a good deal further. Having at last identified at least one of the effective substances in tar, they have studied allied compounds and derivatives and have established what may be called a carcinogenic constitution, so that the probable action of any substance may to some extent be predicted from its structural formula. All this helps to rationalise the overwhelming hygienic case against tar and soot as causes of external cancers: it seems possible also that it may explain the origin of some internal cases, for some of the active substances are related to the sterols, bile acids and œstrin, which are normal components of the body. Conversely, as Prof. E. C. Dodds has shown, some substances which produce tumours are also effective in causing œstrus and sex changes in the plumage of birds.

A New Radioactive Element beyond Uranium

THE Czechoslovak newspapers reported on July 5 that an element of higher atomic weight than uranium has been discovered in Joachimsthal pitchblende by Dr. O. Koblic. The element has been assigned the atomic number 93 and its atomic weight has been found to be 240 from an analysis of the silver salt, $Ag(93)O_4$. The new element would be a congener of manganese and of rhenium, which was discovered in 1925. It should thus form an acid analogous to $HReO_4$ and also salts similar to the permanganates and perrhenates. Acting upon the supposition that the sodium salt of $H(93)O_4$ would be very soluble, Dr. Koblic concentrated the mother liquor from the alkali treatment of pitchblende in the extraction of uranium and radium compounds, and the acidified filtrate was precipitated first with silver nitrate and finally with thallium nitrate. This gave the expected $Tl(93)O_4$ as a red crystalline precipitate. It was re-converted into the more soluble yellow silver salt, 115 milligrams of which were obtained. The discoverer has suggested the name "Bohemium" for the new element, which he considers is probably the parent element of protactinium and the disintegration products of the actinium series. It is estimated that crude pitchblende contains about one per cent of the new element. It will be recalled that Prof. E. Fermi, of Rome, who is investigating the products of neutron bombardment of various elements, recently reported the discovery of an element of atomic weight exceeding that of uranium (see NATURE, June 16, p. 898).

Low Temperature Exhibition in the Science Museum

THE Science Museum—the National Museum of Science and Industry at South Kensington—has made for itself an enviable reputation by the special temporary exhibitions held in the past few years to illustrate the progress which has been made in various branches of science and technical industry. The most recent exhibition, which comes to an end on August 31, shows the public the principles and applications of refrigeration. In the original scheme, it was intended to include a few exhibits to show the progress which has been made in very low temperature work from the days when Faraday demonstrated that certain gases could be liquefied. It was soon realised, however, that the subject was too big and too important to be included merely as a branch of the present exhibition, and it was decided to devote to it an independent exhibition. As the result of a meeting arranged by Col. E. E. B. Mackintosh, director of the Science Museum, of scientific workers, industrialists and representatives of Government institutions interested, to consider the proposal, a small committee has been appointed to decide upon suitable exhibits. The exhibition will commence in March 1935 and will be on view for two months. The arrangements will be in charge of Mr. T. C. Crawhall, the officer of the Museum who was responsible for arranging the present refrigeration exhibition.

THE two laboratories in Great Britain which specialise in low temperature work, namely, the Clarendon Laboratory at Oxford, under Prof. F. A. Lindemann, and the Royal Society Mond Laboratory at Cambridge, under Prof. P. Kapitza, have offered the Museum their advice and assistance, and the Committee, under the chairmanship of Mr. H. T. Tizard, includes other well-known scientific workers and representatives of industrial organisations. The exhibition is primarily intended to show the properties of substances in the following low temperature regions:—solid carbon dioxide, liquid air, liquid hydrogen and liquid helium. As the use of these gases involves the liquefaction of gases obtained from the air, there will be exhibits to illustrate how the liquefaction and separation of these gases is performed in the laboratory and on an industrial scale, while the properties and uses of the gases and liquids will also come within the scope of the exhibition. The scheme is an ambitious one and there is no doubt that, with the support which the Science Museum has already received, it should result in an exhibition of great importance and interest. Col. Mackintosh desires that it should be comprehensive and he will welcome suggestions from anyone who has not so far been approached.

The Radcliffe Observatory

WHEN in the Court of Chancery on July 2 Mr. Justice Bennett approved in principle the application of the Radcliffe Trustees for permission to remove their observatory from Oxford to a site on the high veld near Pretoria, this project, which has been the subject of discussion for several years, reached a further and important stage in its development. Although the judge has reserved his final sanction of the scheme until he is satisfied as to certain details of law and finance, it is not anticipated that these will give rise to any serious difficulty. The Radcliffe Trustees have from the outset wished for some system of close co-operation between the observatory in South Africa and the University of Oxford, and it is intended that the scheme submitted to the judge for his final sanction shall set forth plans for such co-operation in a more concrete form than has hitherto been possible. The present buildings of the Radcliffe Observatory have to be vacated in the summer of next year, when they will be taken over by the Oxford Medical School, but several years must clearly elapse before the new observatory with its 72-inch telescope will be able to commence operations on the site on the hills outside Pretoria most generously presented by the municipality of that city. When it does, it will find waiting for it a vast field of nebulæ and faint stars yet unexplored with the spectroscope.

Heavy Hydrogen

THE intensive research on the new hydrogen isotope, 'heavy hydrogen', of mass 2, and on its oxygen compound, 'heavy water', some aspects of which have been summarised in NATURE (132, 536, 1933; 133, 197, 881, 1934), has given rise to an extensive literature. It was to be expected, therefore, that a monograph on the subject would be written, and two such have recently appeared. In that of Prof. E. Darmois ("Un Nouveau corps simple : le Deuterium ou Hydrogène Lourd", *Actualités Scientifiques et Industrielles*, No. 121. Paris, Hermann et Cie, 1934, pp. 24)—to consider them in alphabetical order of authors—a brief account of the course of discovery, the methods of separation, and the properties of heavy hydrogen and heavy water are reviewed, with useful numerical data. There is a short account of the utilisation of the deuterium (heavy hydrogen) nucleus in atomic disintegration, and of the compounds of deuterium apart from the oxide. The monograph of Prof. H. Mark ("Das Schwere Wasser". Leipzig and Vienna, F. Deuticke, 1934, pp. 32) covers much the same ground, but is rather fuller in some parts than that of Prof. Darmois, and the converse is also true, so that both monographs are necessary in obtaining information on the whole range of the subject up to the date when they were written. Readers of NATURE who desire information on the subject of heavy water will find these monographs very convenient and useful: it is noteworthy that many of the communications listed in the bibliographies have appeared in our columns.

Chlorination of Water Supplies

AT the recent annual meeting of the British Waterworks Association, Prof. P. S. Lelean dealt with the history and present state of the methods of chlorination of water supplies. The process was used in 1897 after an enteric outbreak at Maidstone, and its application on a large scale began in 1900 at Ostend; but the modern process, in which much smaller amounts of chlorine are used, was first put into operation in connexion with the London supplies on the initiative of the late Sir Alexander Houston. The method was extensively used during the War, when perfectly safe drinking water was procured in large amounts from canals and other sources of highly polluted water. In modern practice, bleaching powder has been replaced by chlorine from liquid chlorine. One part of chlorine in ten millions can reduce *Bacillus coli* from 1,000 to 2 per c.c. in ten minutes. The chloramines formed by the action of chlorine on ammoniated water, however, are much more effective than chlorine alone. In the case of Thames water, an addition of 0·1 parts per million of ammonia, filtration, and addition of 0·25 parts per million of chlorine resulted in the absence of *B. coli* from 98 per cent of the samples of 100 c.c. Growth from spores is also considerably retarded. The process causes neither taste nor odour. Prof. Lelean dealt with many aspects of water chlorination in detail, and his lecture emphasised the very great service rendered to public health by the use of scientific methods by the authorities responsible for water supplies: in London, 280 million gallons per day are treated.

Water Supplies in Rural Districts

THE British Electrical Development Association, Inc., has recently issued a report on water supplies and sewage disposal in rural and small urban districts in Great Britain. The report is one which should be

of use to many authorities who to-day are faced with the problem of improving water supplies. The extension of the electricity grid will naturally lead to the installation of electrical pumping plant in preference to steam and oil-driven plant on account of the possibility of automatic control. Many facts and figures as to cost and maintenance of plants and examples of installations are given, ranging from those suitable for a single house to those for large rural areas. In one district with a population of 17,000 spread over an area of 23,000 acres, a scheme was carried out for supplying 12½ gall. per head, the charge for which was approximately two shillings in the pound on the net annual value of the premises. The amount of water used will, of course, depend largely on the sewage system, but it is generally accepted that 25 gall. per head is a safe figure in planning a rural scheme.

Guide Books and Museums

Two guides to the palæontological collections of the British Museum (Natural History) have recently been issued. One of them, the "Guide to the Fossil Birds, Reptiles and Amphibians", claims to be "rather the first edition of a new Guide than a new edition of the old", while the other, the "Guide to the Fossil Mammals", is a reprint "altered and corrected where necessary" (London: British Museum (Natural History), 1*s*. each). Both guides call for criticism. In the first place it is a little difficult to know to what class of reader they are addressed. If for the serious student of palæontology, they are not sufficiently full and contain some rather serious errors, while to the visitor who only wishes to take an intelligent interest and have a little of the veil lifted, they are likely to be wellnigh unintelligible. This difficulty might perhaps be overcome by the use of material already to hand. In 1923 there was published a guide to the exhibition galleries of geology and palæontology, which, rewritten if necessary and with a few well-chosen illustrations, would serve the general public admirably and might be of use to the more elementary of the students. It may also be suggested that a series of separate guides, or guide leaflets, such as are to be found issued by the American Museum of Natural History, would serve a useful purpose. In fact, this plan is already partially in operation in the Natural History Museum. There is a "Guide to the Fossil Remains of Man", published in 1915 at a price of fourpence and a guide to the "Elephants (Recent and Fossil)" published as a second edition in 1922 for a shilling, both very satisfactory. Detailed criticism of the two guides under notice is out of place here, but it may be remarked that neither gives a clear idea of the evolution or classification of groups, while the purpose of some of the illustrations is obscure. It is to be hoped that the authorities will consider not a republication from time to time of matter which has served its purpose and has in course of time become obsolete, but an entire replanning and rewriting of guides to the national collections to meet the two distinct calls made on them, by the student and by the general public.

Average Temperatures in the British Isles

THE number of persons requiring information about the temperature normally experienced in different parts of the British Isles, for one purpose or another, has for many years been large enough to make it an important part of the work of the Meteorological Office to secure so far as possible that standard methods of obtaining air temperature shall be followed both at official and private meteorological stations, and that summaries of these records in comparable form shall be available for inquirers. In a recent handbook ("Averages of Temperatures for the British Isles." H.M. Stationery Office. 9*d*., postage extra) monthly and annual averages of the daily maximum and minimum temperature are given, so far as possible, for the years 1901–1930. As there are, however, many stations for which the averages can refer to only a portion of that period, the inquirer has to be warned against indiscriminate comparisons; for example, differences between a pair of stations for which the period of years referred to is not the same may be due more to peculiarities of the two periods than to real climatic differences; there is the further pitfall of possible differences in times of setting of the maximum and minimum thermometers at the two places. These matters are dealt with in the introduction and the necessary information is shown against each set of figures. It may be observed that the precise meaning of the 'normal' or 'average' maximum or minimum temperature for a given season and a given place is not easily defined. In Table I of the "Book of Normals", which the tables under review supersede, the mean temperature at Kew in January (or rather the mid-point between the mean daily maximum and mean daily minimum) is given as 38·9° F., whereas in the new tables it appears as 40·4° F. The relatively low figure in the "Book of Normals" is due partly to the fact that in the period covered therein (1881–1915) there was a notable run of cold winters, those of the early 'nineties, while the winters of 1901–30 have mostly been mild; there is no means of knowing whether the next 30 years will give an average or 'normal' near to 38·9° F. or one nearer to 40·4°.

British Empire Broadcasting

SOME of the difficulties overcome by the British Broadcasting Corporation in establishing a broadcast service between Great Britain and distant regions of the Empire are well described in a paper in *Electrical Communication* of April by C. M. Benham and P. H. Spagnoletti. Except in special cases, long distance radio communication is practical only when short wave-lengths are used. It was necessary therefore to use radio equipment of the short wave type. Fortunately, the colonies and dominions are so distributed longitudinally that they can be conveniently divided into time zones, that is, areas which have approximately the same local time. There are four main zones: Australia, which has a time displacement relative to London of 'eight hours early'; India, 'four hours early'; Africa, the same time; and Canada, 'six hours late'. In the case

of Australia, the farthest away, transmission must travel through twilight conditions whichever path round the world is used. It was not expected therefore that wave-lengths of 15 metres, using the daylight path, or 37 metres using the dark path, would give trustworthy service. Both can be used for short periods but their useful duration is limited and uncertain. The twilight band (25–29 metres) has been found to be the best. In the Indian zone it has been found that 17 metre transmissions are very satisfactory. In the case of Africa, as it lies almost due south, shorter wave-lengths are used during the day, intermediate wave-lengths at dusk and at night-time 32 metre wave-lengths or even longer can be used. It is found better to divide Africa into two zones. The great circle path to Canada passes very near to the north pole and even in summer it is not a true daylight path. A satisfactory day wave for Canada is of the order of 19 metres, but night waves of 31 and 50 and sometimes as high as 70 or 80 metres have been used. The B.B.C. deserves great credit for having overcome so successfully many of the difficulties connected with the most ambitious project ever attempted in broadcasting.

Standardisation of Electricity Supply

In a paper read on May 31 to a meeting of the Incorporated Municipal Electrical Association (the I.M.E.A.), which was held in Liverpool, L. Romero discussed the standardisation of methods for distributing electricity and for its sale. He recently addressed a questionnaire to sixty of the largest municipal supply undertakings in Great Britain, and nearly all had replied explaining the systems they used and in particular the voltages which they adopted to supply their consumers. It was decided officially some years ago that the standard system of supply should be the alternating current system and that the standard pressure for domestic supply should be 230 volts. The replies received show that about a third of the municipal undertakings are maintaining voltages which are not standard and that the number of consumers using these voltages is rapidly increasing. The reason given for not adopting the standard is that the change would be expensive. This is a short-sighted policy, as it causes expense to consumers and is a definite obstacle in the way of cheapening electrical lamps and appliances. Several countries abroad also suffer from this lack of standardisation. Luckily, in Great Britain, the progress made in changing from D.C. to A.C. supply is much more satisfactory. Many people think that the supply of electricity should be managed on a national basis, their principal argument being the lack of standardisation that otherwise ensues. Presumably local authorities desire to manage their own electricity supply. Some of them would therefore do well to regard standardisation from a broader point of view.

Electrification of Collieries

Although great progress has been made during recent years in the electrification of collieries, about one third of the total power utilised is still generated mechanically. According to the *Electrical Review* of June 29, the total horse-power of the motors in use in collieries is now about 1,900,000. This is equivalent to more than ten per cent of the capacity of all the plant connected to the public supply mains in Great Britain. Of the electricity used, only about thirty per cent is supplied by statutory authorities. Doubtless this percentage will rapidly increase, as power can be produced more cheaply at points away from the pithead where a more abundant water supply is available for condensing purposes. It is satisfactory to notice that, despite the increase in the use of electricity, the number of electrical accidents is steadily decreasing. This is due to the design of flame-proof structures and flame-proof apparatus. Owing to the high standards adopted by the Association of Mining Engineers, the costs of maintenance have also rapidly diminished. The fixing of minimum standards for illumination for portable lamps is a notable advance. We think that inventors ought to turn their attention to the development of a fixed lighting system which would be safe to use at all parts of the coal face.

Interference with Radio Supply by Electric Lighting

It is well known that when direct current supply is used for electric lighting, the contacts of the switches and fuses often get badly corroded after a few years' operation. This usually causes little, if any, inconvenience in the lighting of the house or in the use of electric appliances, but if a radio receiver be installed the loud speaker produces most unpleasant noises. This is often attributed quite wrongly to some fault in the set. In many cases the noises are got rid of by having the electric wiring overhauled. According to a paper in the *Electrical Review* of June 1 by V. Z. de Ferranti, many domestic electrical appliances also cause bad radio reception. As examples he gives electric bells operated from the mains, children's electric toy trains, a bad contact in an electric fire and, worst of all, any piece of equipment driven by a motor. He points out that it is far easier to supply equipment which can be trusted to cause no interference than to eliminate by special devices the interference caused by equipment already installed. The special devices are often expensive. He estimates that there are now two and a half million mains-operated radio sets in Great Britain. Collectively, they take about 150,000 kilowatts and the average demand is about two hours a day. In addition, the demand for this load is outside the busy hour of supply and it is therefore desirable to the electricity companies. There is quite an appreciable number of small house-holders who have availed themselves of electric supply primarily in order to be able to use it for radio receiving sets.

Secret Radio-telephony

A Science Service Mail Report dated May 28 states that Dr. S. Chiba, of the Tokyo Electric Co., has developed a secret method of radio-telephonic communication. According to the description, the

sending installation employs a microphone so constructed that the speech current is inverted with respect to frequency, so that it is unintelligible to the listener on an ordinary receiver. At the receiving end of the communication channel an equipment is used to turn the speech back to normal. From these brief details, it would appear that the system is similar to the inverted-speech method employed by the British Post Office for securing secrecy, as an alternative to the speech-scrambling method which has also been developed and used by the Post Office in long-distance radio-telephonic communication.

Research on Lawns

IT is gratifying to learn that the British Board of Greenkeeping Research will be enabled to maintain its Research Station at St. Ives, Bingley, Yorks, for a further period of five years. Vol. 10, No. 3 of the Board's *Journal* contains a review by the Director of the past four and a half years' work at the Station. There is also a continuation of the series of articles by Mr. I. G. Lewis, describing common grasses. Redtop (*Agrostis stolonifera*, L., var. *gigantea*, Koch) and velvet bent (*A. canina*) are considered in the present volume. The former is somewhat coarse for fine lawns, but the latter is the queen of putting green grasses. Mr. Arthur Hill describes his experiments on lawns at Craibstone, whilst the Director of the Bingley Station, Mr. R. B. Dawson, continues his articles on "Common Weeds of Turf". Dr. T. W. Evans also contributes a paper on phosphatic fertilisers in relation to greenkeeping, and Mr. R. Gordon, of Prestwick Golf Club, writes on "A Golf Course under Seaside Conditions".

Royal Society of New Zealand

THE inaugural meeting of the newly formed Royal Society of New Zealand (hitherto called the New Zealand Institute) was held at Wellington on May 16, when the presidential address was delivered by Prof. R. Speight, professor of geology at Canterbury College, Christchurch, New Zealand. Lord Bledisloe, the Governor-General of New Zealand, in a written address to the Society, intimated His Majesty's approval of the new designation of the Dominion's chief organisation for the promotion of science. The New Zealand Institute was founded in 1867 and the fellowship of the new Society is held by forty-eight men of science. In his address, Lord Bledisloe emphasised the importance of science in solving the world's economic and social problems. Only by the further application of science in all its ramifications and a more enlightened recognition of its beneficent potentialities by the world's rulers will effective remedies for current human disorders be found. The New Zealand Institute has achieved a high prestige in a land of immeasurable opportunities for industrial and cultural expansion. It is therefore to be hoped that under its new appellation it will enjoy to an ever-increasing extent the confidence and respect of the community at large.

Dorothy Temple Cross Fellowships in Tuberculosis

THE Medical Research Council has made the following awards of Dorothy Temple Cross Fellowships for 1934–35, under the terms of the benefaction in that name for research fellowships in tuberculosis: Mr. W. S. Creer, Lady Jones Orthopædic research fellow, University of Liverpool; Mr. A. W. Franklin, chief assistant to Children's Department, St. Bartholomew's Hospital, London; Dr. P. D'A. Hart, assistant physician, University College Hospital, London; Mr. A. Landau, house physician, Brompton Hospital, London: Mr. A. H. T. Robb-Smith, senior demonstrator of morbid anatomy, St. Bartholomew's Hospital, London. Mr. Robb-Smith's fellowship is tenable in Germany, the others at centres in the United States. In addition, the fellowship awarded last year to Dr. G. G. Kayne for work at centres in Europe has been renewed for a further period of six months.

Books on Social History and Early Travel

MESSRS. FRANCIS EDWARDS's Catalogue No. 572 of new and second-hand books on "History throughout the Ages" contains items of even more extended interest than the title suggests. Not only does it include source books, but also in its extra-European sections there are a number of early travel books and other works of value for their early records of ethnographical material. Among items of particular interest to the social historian is a remarkable run of the *London Gazette*, Nos. 1–4825, dating from November, 1665 to March 24, 1710, in thirteen folio volumes, in contemporary calf. The early numbers include notices of the Plague, indicating the rapid decrease then showing in the figures. The accounts of the Fire of London are followed by schemes for rebuilding the city. Another item of similar interest is Higden's "Polychronicon" in the Rolls Series, now partly out of print. Among official papers is a complete set of the reports of the Historical Manuscripts Commission to 1926. An *editio princeps* of the Nuremburg Chronicle in Gothic letter of 1493 contains 1800 woodcuts, among which appears a portrait of Pope Joan. Early travel books include Hakluyt in black letter, the "Relations" of the Jesuits in Canada (1858), Burney's South Seas, Callander's Australian voyages, Fornander's "Account of the Polynesian Race", Dalrymple's voyages in the South Pacific and Kæmpfer's history of Japan.

Percival Collection of Seeds of British Plants

THE Department of Agricultural Botany of the University of Reading has acquired the Percival Collection of seeds of British plants. This collection, which took about forty years to put together, contains mounted and named seeds of more than a thousand species. Although the British flora is not completely represented, the collection is by far the most adequate in Great Britain and is invaluable for reference purposes. Prof. W. B. Brierley, professor of botany at Reading, hopes that field botanists will

assist him in completing this collection and states that he will be glad to supply lists of the species still unrepresented.

Royal Society of Medicine of Ghent

The centenary of the foundation of the Royal Society of Medicine of Ghent was celebrated on May 26 in the presence of some three hundred medical men from all parts of Belgium and France under the presidency of Dr. Van Cauwenberghe. The inaugural meeting, in which the history of the Society was related by the secretary, M. de Bersaques, was followed by a scientific gathering at which papers were read by Profs. Leriche of Strasbourg, Polak Daniels of Gröningen and Dr. Ragin of Lausanne.

Announcements

We much regret to announce the death, at the age of seventy-nine years, of Dr. L. Cockayne, F.R.S., honorary botanist of the State Forest Service of New Zealand; and also of Dr. N. L. Britton, emeritus director of the New York Botanic Garden, on June 25, at the age of seventy-five years.

The Rogers Field Gold Medal of the Royal Sanitary Institute has been awarded to Imperial Chemical Industries Ltd., for an exhibit of Chloros at the Bristol Congress of the Institute just concluding. The medal is given for an exhibit of outstanding merit from the point of view of hygiene. The special features of the Chloros exhibit at Bristol were its uses in connexion with the sterilisation of rural water supplies and swimming pools.

The Secretary of State for the Colonies has appointed Mr. A. C. Miles, provincial superintendent of agriculture, to be deputy director of agriculture, Gold Coast.

Dr. R. C. Bowden, chemical engineer under the Director of Ordnance Factories, has been appointed by the War Office to be Superintendent, Royal Gunpowder Factory, Waltham Abbey, in succession to Lieut.-Col. P. H. Evans, Royal Artillery, who retires on July 12.

The trustees of the Bernhard Baron Charitable Trust have made a grant of £10,000 to the British Empire Cancer Campaign in response to its Empire Day appeal. The money will be put in a special fund to be called the "Bernhard Baron Cancer Fund".

The annual Autumn Meeting of the Institute of Metals will be held at Manchester on September 3–6, under the chairmanship of Dr. Harold Moore, president of the Institute. On September 3, Dr. J. L. Haughton will deliver the thirteenth Autumn Lecture entitled: "The Work of Walter Rosenhain". Further information can be obtained from the secretary of the Institute, 36 Victoria Street, London, S.W.1.

In 1920, Miss L. Jones-Bateman, of Cae Glass, Abergele, presented to the Royal Horticultural Society a valuable silver-gilt replica of the Warwick vase to be used for the encouragement of fruit production. It has accordingly been decided to offer it triennially for researches in the growing of hardy fruits, figs, grapes and peaches in the open or under glass, and it is available for award in 1934. Candidates should submit accounts of their work by October 31. The work dealt with must have been carried out by the candidate in the United Kingdom mainly during the past five years.

Messrs. Longmans, Green and Co., Ltd. announce for publication in September a work by Mr. G. C. Robson, deputy keeper of zoology at the British Museum (Natural History), and Mr. O. W. Richards, lecturer in entomology at the Imperial College of Science and Technology, entitled "Variations of Animals in Nature". In this work the authors have summarised the evidence on the subject in an attempt to decide what evolutionary theory is in best agreement with the facts.

Applications are invited for the following appointments, on or before the dates mentioned:—A part-time assistant in statistics at the London School of Economics and Political Science, Houghton Street, Aldwych, W.C.2—The Secretary (July 17). An assistant lecturer in electrical engineering at the York Technical Institute—The Secretary for Education, Education Offices, Clifford Street, York (July 18). An assistant lecturer in the Department of Zoology, preferably a vertebrate morphologist, at University College, London, W.C.1—The Secretary (July 18). A head of the Department of Geology, Mineralogy and Geography at the Chelsea Polytechnic, London, S.W.3—The Principal (July 21). A lecturer (man) to take charge of the Post-Graduate Training Department of University College, Leicester—The Registrar (July 21). A lecturer in engineering at the Denbighshire Technical Institute, Wrexham—The Principal (July 21). A teacher of engineering at Leigh Municipal College—The Director of Education, Town Hall, Leigh (July 21). An assistant lecturer in geography at University College, Exeter—The Registrar (July 28). A deputy director and bacteriologist at Adelaide Hospital, who will also be lecturer in bacteriology in the University—The Agent General for South Australia, Australia House, Strand, London, W.C.2 (Aug. 15). A biochemist or chemist, preferably with knowledge of physical chemistry and biology, for an investigation into the effect of oil upon mosquito larvæ, at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1—The Secretary (Sept. 7). A professor of mathematics in Victoria University College, Wellington, New Zealand—The Secretary, Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1. Demonstrators in mechanical engineering, electrical engineering and communications, and physics, at Woolwich Polytechnic, London, S.E.18—The Secretary. A teacher of mining and engineering in East Kent—The Acting Principal, Technical Institute, Ladywell, Dover.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

An Early Record of the Sycamore Maple in Britain

THE sycamore maple, *Acer pseudoplatanus* L., is one of the hardiest of British trees, sometimes suppressing the elm by the vigour and rapidity of its growth. According to Henry[1] it thrives in almost any dry soil, and seems to reach its greatest size and perfection in the colder hilly parts of England and Scotland, "where nearly all the finest specimens are found". It is unaffected by the severest frosts, at any season, and is rarely attacked seriously by insects, or by fungi except *Rhytisma acerinum* (Pers.) Fries, which produces noticeable black blotches on the leaves. The sycamore maple ripens seed profusely and reproduces itself almost everywhere on clean ground, though the seedlings are easily suppressed by coarse grass. Bean[2] notes that its seedlings spring up in the wilder parts of Kew Gardens in such a way that in course of time the place, if left to run wild, would probably become a sycamore forest. He points out that this is one of the few trees that will stand the full force of salt-laden winds in exposed places near the sea. Last year I found it growing on the coast of Caithness exposed to the full fury of the north wind.

It seems strange that such a hardy and adaptable species should not be indigenous to Great Britain, yet Henry[1] states that it is not a native of the British Isles, nor of north-west France, Belgium, Holland, the North German plain, Denmark, Scandinavia, or the greater part of Russia. In these countries, however, it "flourishes and is extensively cultivated". Its centre of distribution appears to be the great central chain of the Pyrenees, Alps and Carpathians, with the mountains and hills radiating from them; it occurs wild also in Asia Minor, Armenia and the Caucasus[1]. Smith[3] refers to it as occurring "In sepibus, et ad domos, vix indigena". Ray[4] states that in his time it was planted in cemeteries and about the houses of the nobility, and that it was nowhere wild in England: "In coemiteriis & circa nobilium aedes: nullibi tamen, quod sciam, in Anglia sponte oritur" (3rd ed., p. 470, 1724). Turner, 1551[5] and Gerarde, 1597[6] refer to it as a stranger, or introduced tree: "The great Maple is a stranger in England, only it groweth in the walkes and places of pleasure of nobelmen, where it especially is planted for the shadow sake, and under the name of Sycomore tree" (6, p. 1300). Hyde[7] observes that the sycamore maple is "not a native of Wales, or indeed of Great Britain, but was introduced from the Continent of Europe, probably during the sixteenth century". The late Clement Reid[8] writes of the sycamore as "undoubtedly introduced", and suggests the possibility of its having been planted by Roman officers around their villas, for shade and beauty, along with the Spanish chestnut.

Examining recently some beautiful stone carvings in the Cathedral of Christ Church, Oxford, I was impressed by the fact that one of them represents, quite clearly and unquestionably, *Acer pseudoplatanus*, although they date from the end of the thirteenth (or early fourteenth) century. Ten species are depicted, seven of which are native British plants, and the others cultivated. They represent: *Acer campestre* L., *Quercus robur* L. (*sensu stricto*, that is, *Q. pedunculata* Ehrh.), *Crataegus monogyna* Jacq., *Hedera helix* L., *Aquilegia vulgaris* L., *Chelidonium majus* L., *Bryonia dioica* L., *Vitis vinifera* L., *Ficus carica* L. (?), and *Acer pseudoplatanus* L. The grape-vine and the fig-tree, both perhaps introduced by the Romans, were much grown in English gardens in the sixteenth century. Gerarde[6] says: "The Fig trees do growe plentifully . . . in England, where they beare fruite." They were valued as medicinal plants: according to Culpepper[9], fig-trees "prosper very well in our English gardens, yet are fitter for medicine than for any other profit which is gotten by the fruit of them".

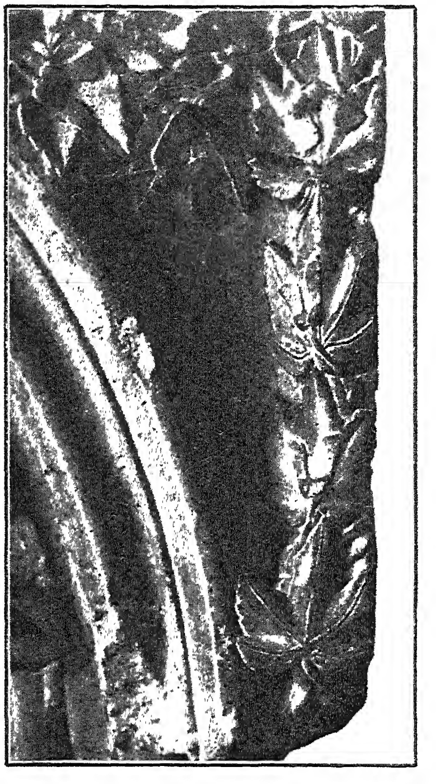

FIG. 1. The sycamore maple, *Acer pseudoplatanus* L., on the canopy of the tomb of St. Frideswyde in the Cathedral of Christ Church, Oxford.

The carvings referred to are on the canopy of the shrine of St. Frideswyde. This shrine was erected in the year 1289; the carving is attributed to the period 1290–1320. The late Dr. Wells[10], Warden of Wadham College, wrote of it as "the earliest known instance in England of natural foliage in architectural decoration".

A list of species is given on a card placed on the shrine for the information of visitors. The only one about which there seems to be any possible doubt is *Ficus carica*.

As seven of the ten species represented are native British plants, and the other three were commonly cultivated in Britain, and as the carvings are remarkably true to Nature, there seems no reason to doubt that they were designed from living specimens grown in or near Oxford. If this be so, it places the introduction of *Acer pseudoplatanus* into England about a quarter of a century earlier than the approximate

date generally assigned to it, and the St. Frideswyde carving appears to be the earliest known illustration of the sycamore maple in Great Britain.

I am indebted to the Very Rev. the Dean of Christ Church for courteous permission to take the photograph here reproduced (Fig. 1).

J. BURTT DAVY.

Imperial Forestry Institute,
Oxford.
June 14.

[1] Henry, A., in Elwes and Henry, "Trees of Great Britain", vol. 3, pp. 645–646; 1908.
[2] Bean, W. J., "Trees and Shrubs Hardy in the British Isles", (2nd ed.), vol. 1, p. 155; 1919.
[3] Smith, Sir J. E., "Flora Britannica", vol. 1, p. 422; 1804.
[4] Ray, John, "Synopsis Methodica Stirpium Britannicarum", p. 230; 1690.
[5] Turner, William, "A Newe Herball . . .", Part 1; 1551.
[6] Gerarde, J., "The Herball", 1597; and edit. 2, enlarged and amended by Thomas Johnson, 1633.
[7] Hyde, H. A., "Welsh Timber Trees", p. 86; 1931.
[8] Reid, Clement, "The Origin of the British Flora", p. 16; 1899.
[9] Culpepper, N., "The English Physitian", enlarged. London, 1653. Many subsequent editions appeared; Dr. Daydon Jackson mentions one in Welsh, issued in Caermarthen in 1818; my own copy was published at Halifax, but bears no date.
[10] Wells, J., "Oxford and its Colleges", 13th ed., p. 21; 1926.

Effect of Temperature on Diffraction of Slow Electrons and its Application

WE have investigated the influence of temperature on the intensity (I_T) maxima due to the diffraction of slow electrons from a cleavage plane of Ceylon graphite, using the method of constant Bragg angle ($\theta = 65°$). The apparatus used in these experiments is described in detail elsewhere[1].

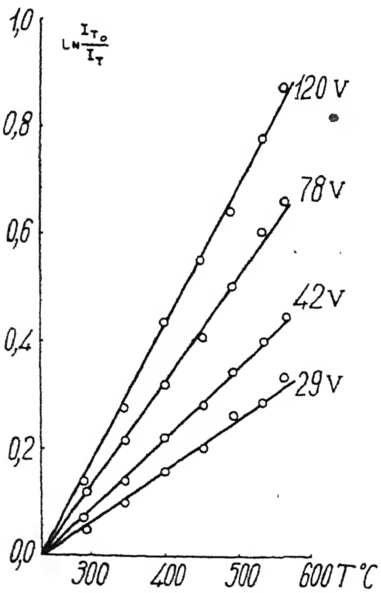

FIG. 1.

Fig. 1 gives graphs of $\ln I_{T_0}/I_T$ against T, the temperature of the experiment. Every straight line corresponds to a definite maximum the value of which in volts is indicated. In Fig. 2 voltages of the maxima are plotted against the values of $1/(T-T_0) \ln I_{T_0}/I_T$. The empirical relation between the intensity of the maxima and temperature is then:

$$I_T = I_{T_0} e^{-q(V+\psi)(T-T_0)} \quad (1)$$

where the constants have respectively the values $q = 2 \cdot 0 \times 10^{-5}$ grad^{-1} volt^{-1}, $\psi = 22$ volts.

It is known that the Debye thermal factor for X-rays has the following form

$$I_T = I_{T_0} e^{-a\frac{\sin^2\theta}{\lambda^2}(T-T_0)} \quad (2)$$

Moreover, if the refraction of electronic waves is taken into account, the introduction of the value φ of inner potential permits the following transcription of equation (2):

$$I_T = I_{T_0} e^{-a\frac{\sin^2\theta}{150}\left(V+\frac{\varphi}{\sin^2\theta}\right)(T-T_0)} \quad (3)$$

where V is measured in volts.

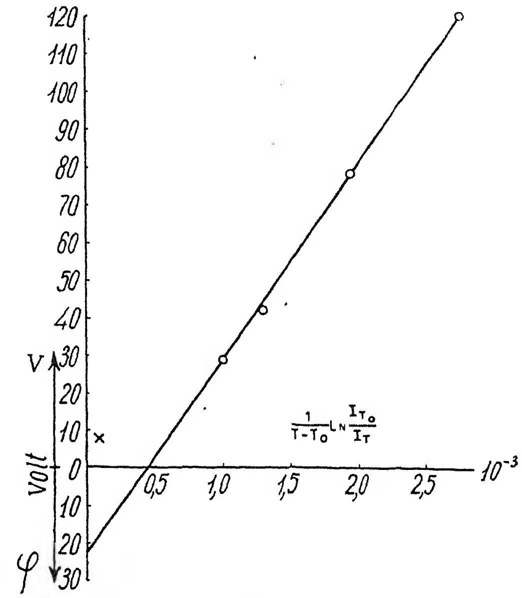

FIG. 2.

The constant a (for X-rays) may be computed for graphite from Bakhurst's data[2], which give the value $a = 0 \cdot 0038$ A.^{2} grad.$^{-1}$. The use of our value for q, obtained from experiments on electronic diffraction, leads to very nearly the same result: $a = 0 \cdot 0036$ A.^{2} grad.$^{-1}$. The constant ψ, multiplied by $\sin^2\theta$, may be easily identified with inner potential, a result which follows from the comparison of formulæ (1) and (3); thus we obtain $\varphi = 18$ volts in good agreement with the value (20 volts) found earlier[2].

We wish to point out that in order to obtain the value of φ by this procedure, a knowledge of the Millerian indices of the maxima is no longer necessary. We may thus propose a method of controlling the correctness of determination of plane indices. The maximum observed at 8 volts (marked by the cross in Fig. 2) has shown an almost negligible temperature effect, in striking contrast with the general results. This fact forced upon us the conviction that this maximum does not arise from the space lattice. In fact, special investigation has shown that this maximum is due to a selective change of the coefficient of reflection on the surface layer of graphite and does not belong to the diffraction maxima.

The detailed account of our research will be published in *Phys. Z.S.U.*

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G. A. KUZMIN.

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Leningrad.

[1] W. E. Laschkarew, E. W. Bärengarten and G. A. Kuzmin, *Z. Phys.*, **85**, 631; 1933.
[2] I. Bakhurst, *Proc. Roy. Soc.*, A, **102**, 340; 1923.

The Chlorine–Chlorine Distance in Carbon Tetrachloride

THE chlorine–chlorine separation in carbon tetrachloride has been given as 2·99 ± 0·03 A. by Bewilogua[1], from X-ray diffraction measurements, and as 2·98 ± 0·02 A. by Wierl[2], from electron diffraction experiments. Recently Dornte[3], and Hendricks, Maxwell, Jefferson and Mosley[4], have mentioned confirmation of these values, but Braune and Knoke[5], and Brockway and Pauling[6] have obtained smaller values, all using the electron diffraction method.

In the course of further work with this method, carried on independently in our respective laboratories, we have effected considerable improvements in the experimental technique, so that we are now able to measure up to the seventh order with accuracy. Our results with carbon tetrachloride prove to be much lower than those previously reported. The mutual agreement of our independent results almost eliminates the possibility of a consistent experimental error. At the same time, the case has been thoroughly investigated as regards possible sources of error; the voltmeters used were calibrated against diffraction photographs of gold foil. We have recalculated the complete theoretical scattering curve for carbon tetrachloride with respect to electrons, taking account of the atomic scattering factor and incoherent scattering corrections. The resulting curve differs very slightly from that given by Wierl[2].

The accompanying sets of results represent the mean of numerous readings, both direct and photometric, from the positives and negatives of twelve good plates:

Maxima	1	2	3	4	5	6	7	
$L_{Cl.-Cl.}$	2·71	2·74	2·87	2·83	2·85	2·83	2·85 A.	(V. E. C.)
	2·69	2·74	2·84	2·84	2·87	2·88	2·84 A.	(H. de L.)

The first two maxima yield very low results, due to uncertainty in measurement, or more probably to the position of the apparent intensity maxima being influenced, in this region of high density, by the rapid change in slope of the intensity-blackening curve for the plate[7]. One of us (V. E. C.) has developed a method for the compensation of the continuous background scattering, which gives values of 2·84, 2·79 and 2·86 A. for the first three maxima respectively. This indicates that the initial error in the first and second maxima lies in the measurement, and not in the experimental method or the theoretical scattering curve.

Taking these results into consideration, we get a mean value for the chlorine–chlorine separation in carbon tetrachloride of 2·86 ± 0·03 A.

This work will be published in full elsewhere.

V. E. COSSLETT.

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H. G. DE LASZLO.

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May 29.

[1] *Phys. Z.*, **32**, 270; 1931.
[2] *Ann. Phys.*, **8**, 521; 1931.
[3] *J. Chem. Phys.*, **1**, 566; 1933.
[4] *ibid.*, **1**, 549; 1933.
[5] *Z. phys. Chem.*, (B), **21**, 297; 1933.
[6] *Proc. Nat. Acad. Sci.*, **19**, 68; 1933.
[7] Cf. Becker and Kipphan, *Ann. Phys.*, **10**, 15; 1931.

A New Band System of Aluminium Hydride

IN a recent paper[1] we reported on a new band system of aluminium hydride lying at 3380 A. We have now succeeded in photographing this band system in the second order of a 6·5 m. concave grating. As light-source we used an aluminium arc burning in a hydrogen atmosphere at a pressure of 15 mm. with high current (15 amp.).

The band system has been analysed and is shown to belong to a $^1\pi^* \rightarrow {}^1\pi$ transition. It consists of four branches (P_1, P_2 and R_1, R_2), with no Q branches, in agreement with theory. From the analysis it is evident that the lower $^1\pi$ term is identical with the upper $^1\pi$ term of the well-known $^1\pi \rightarrow {}^1\Sigma$ system. The following constants have been found:

	B_0	D_0	J_0	r_0	ω_0
$^1\pi^*$	5·60	$-$ 9·7 × 10^{-4}	4·95 × 10^{-40}	1·76 A.	851·7 cm.$^{-1}$
$^1\pi$	6·026	$-$ 6·66 × 10^{-4}	4·60 × 10^{-40}	1·70 A.	1146·5 cm.$^{-1}$

The upper term $^1\pi^*$ shows a remarkable predissociation at $j=12$ for $^1\pi_c$ and $j=11$ for $^1\pi_d$.

The Λ-doubling has been measured and is given by the following equation:

$$\Delta\nu = 1{\cdot}29(j+\tfrac{1}{2})^2 - 0{\cdot}0163(j+\tfrac{1}{2})^4 - 0{\cdot}867 \times 10^{-4}(j+\tfrac{1}{2})^6$$

The intensity distribution among the branches is of some interest, while the P_1 (R_1) branches, in disagreement with theory, is far more intense than the P_2 (R_2) branches.

A detailed report will be given elsewhere.

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June 14.

[1] *Z. Phys.*, **89**, 40; 1934.

Wireless Echoes from Regions above the *F* Layers

DURING recent years, we have obtained a large number of fixed-frequency continuous automatic records of the cyclic changes of effective layer-heights which constantly occur in the ionosphere, and our record files now cover a period of approximately 11,000 hours. Our most interesting results have been obtained at the frequency of 3,492·5 kilocycles, although we have also made a number of experiments on the simultaneous reception of 4,095 and 2,398 kilocycles. Some of the 3,492·5 kilocycle transmissions have been recorded simultaneously at three different geographical points. The receiving and recording apparatus is compact and reliable, and it can operate at a distant point for at least two weeks without any attention. An accurate time scale is automatically marked on all records by the transmitter.

In addition to the usual stratified multiple *F* layer echoes, and occasional abnormal *E* layers, we have frequently observed first-order echoes which appear to come from regions of considerably greater effective height. We have delayed the announcement of these results as we wished to be reasonably certain that the effects were not due to the low group velocities ordinarily encountered in the *E* and *F* regions when the electron density is near a critical value. With improved sensitivity and resolving power we have recently obtained a series of consistent records which apparently rule out this explanation. We have used four different mechanical designs in constructing

automatic recorders for various types of service. The gaseous discharge lamp[1] gives a positive indication of very weak echoes which are far below the static level. When used under such extreme conditions, the photographic trace shows a series of black echo lines on a dark grey mottled background.

Although it is not yet certain that the refracting regions are directly overhead, it is convenient to describe the experimental results by a tentative classification into '*G* reflections' and '*H* reflections'.

The *G* reflections are much weaker than the *F* reflections. They produce a broad diffuse turbulent trace with a sharply defined lower boundary which normally remains relatively constant from midnight to sunrise. At this geographical location the boundary commonly has an effective height of approximately 600 km. It is ordinarily observed whenever the *F* region is completely penetrable, but it is also frequently present in combination with the various *F* components.

On different occasions the *H* reflections have returned from various effective heights ranging from 1,100 km. to 1,800 km. During a single observation the reflection often remains comparatively steady in signal strength and position for a period of six hours or more. The signals are weak but sharply defined, and the photographic traces are quite different in appearance from those produced by the *G* reflections. A slow steady downward drift has sometimes been observed from midnight to sunrise. On a number of occasions the '*H* layer' has been recorded in the evening hours while lower layers have been present. *G* and *H* layers may be observed at points very close to the transmitter as well as at a distance. The seasonal variation is not yet certain.

The early experiments were made in collaboration with Dr. Pao H. Wang. Mr. Paul B. King has obtained a large part of the recent data.

Harry Rowe Mimno.

Harvard University,
Cambridge, Massachusetts.
May 14.

[1] H. R. Mimno and P. H. Wang, *Proc. Institute of Radio Engineers*, 21, 529; 1933.

Induced Radioactivity and Transmutation

With reference to Fermi's work[1] on the bombardment of elements with neutrons and the production of β-rays, we suggest that the bombardment produces unstable and missing isotopes containing α-particles, a diplon and neutrons. Thus with aluminium the transmutation would be as follows:

$${}_{13}Al^{27}\ [6\alpha + D + n]\ (\text{stable}) + n \rightarrow {}_{13}Al^{28}.$$

The missing isotope ${}_{13}Al^{28}$ is unstable, disintegrating thus:

$${}_{13}Al^{28}\ [6\alpha + D + 2n] \rightarrow {}_{14}Si^{28}\ [7\alpha] + \beta$$

to form the next stable α-particle configuration ${}_{14}Si^{28}$ $[7\alpha]$. Similarly for chlorine:

$${}_{17}Cl^{35}\ [8\alpha + D + n]\ (\text{stable}) + n \rightarrow {}_{17}Cl^{36}\ [8\alpha + D + 2n]\ ;$$

and the latter being unstable and a missing isotope, we have:

$${}_{17}Cl^{36}\ [8\alpha + D + 2n] \rightarrow {}_{18}Ar^{36}\ [9\alpha] + \beta$$

as observed by Fermi. In addition ${}_{17}Cl^{37}$ may be spontaneously radioactive:

$${}_{17}Cl^{37}\ [8\alpha + D + 3n] \rightarrow {}_{18}Ar^{37}\ [9\alpha + n] + \beta\ ;$$

and although such spontaneous radioactivity has not yet been observed, it does occur with potassium. In the case of magnesium—an isotope of even atomic number—

$${}_{12}Mg^{26}\ [6\alpha + 2n] + n \rightarrow {}_{12}Mg^{27}\ [6\alpha + 3n]$$
$${}_{12}Mg^{27}\ [6\alpha + 3n]\ (\text{unstable}) \rightarrow {}_{13}Al^{27}\ [6\alpha + D + n] + \beta\ ;$$

so that β-rays would be emitted as found by Fermi.

Similarly, with silicon,

$${}_{14}Si^{30}\ [7\alpha + 2n] + n \rightarrow {}_{14}Si^{31}\ [7\alpha + 3n]\ (\text{unstable})$$
and ${}_{14}Si^{31}\ [7\alpha + 3n] \rightarrow {}_{15}P^{31}\ [7\alpha + D + n] + \beta$.

Then with phosphorus ${}_{15}P^{31}\ [7\alpha + D + n] + n \rightarrow {}_{14}Si^{31}\ [7\alpha + 3n]$ + proton and ${}_{14}Si^{31}\ [7\alpha + 3n]$ (unstable) $\rightarrow {}_{15}P^{31}\ [7\alpha + D + n] + \beta$. These transmutations agree with Fermi's observation that phosphorus bombarded with neutrons emits protons and electrons, the unstable silicon isotope returning to the original isotope ${}_{15}P^{31}$.

According to our theory of nuclear structure, a full account of which will be published shortly, missing isotopes are unstable, emitting either an electron or a positron. The theory also predicts stable but at present missing isotopes such as ${}_{18}Ar^{37}$ and ${}_{18}Ar^{38}$.

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June 8.

[1] Nature, 133, 757, May 19, 1934.

Induced Radioactivity of Potassium

I have bombarded potassium chloride with the α-rays of radium C′ of 55 mm. effective range and found that it acquires a greater radioactivity than that due to the natural activity of potassium. The effect is due to potassium, because no similar effect was exhibited by sodium chloride irradiated in the same conditions. In order to measure exactly the amount of induced radioactivity, all counting experiments were done by taking the difference between the number of impulses due to two identical samples of potassium chloride, one of which has been irradiated.

Irradiating potassium chloride for 12 hours with 30 millicuries of radon, I have found that the corrected initial activity amounts to about 50 impulses per minute, while the non-irradiated sample gave an effect of 17 impulses per minute. The induced activity decays exponentially with a half-period of 3 hours. I have found that the radiation consists of positrons and is completely absorbed by a sheet of lead of 0·27 gm./cm.^{2}. No positron emission takes place when the range of α-rays is reduced to 45 mm.

The probable reactions are:

(1) ${}_{19}K^{41} + {}_{2}He^{4} = {}_{21}Sc^{44}$ + neutron ;

(2) ${}_{21}Sc^{44} = {}_{20}Ca^{44}$ + positron

or analogous reactions due to the 39 potassium isotope.

In order to test this possibility, I have tried to separate chemically the assumed scandium isotope, with the help of Mr. A. Wronceberg, to whom my best thanks are due. Irradiated potassium chloride was

dissolved in slightly acidulated water, a few milligrams of scandium chloride ($ScCl_3$) added to the solution and precipitated by an excess of ammonia. The precipitate exhibited an activity of the same character and comparable in amount with that emitted by irradiated potassium chloride.

M. ŻYW.

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June 14.

Carotenoids and the Vitamin A Cycle in Vision

SINCE reporting the occurrence of vitamin A in the eye tissues of the frog and several mammals[1], I have examined the carotenoids of the frog's eye in detail.

The combined pigment and choroid layers of *R. esculenta* and *pipiens* (dry weight about 2·2 mgm.) contain about 4γ per eye of vitamin A. There is also about 1γ of another carotenoid in these tissues possessing the spectroscopic and solution properties of xanthophyll. These quantities are not altered appreciably by light or dark adaptation.

In the retinas of dark adapted animals, no xanthophyll and only a trace of vitamin A occurs. Instead, their chloroform extracts contain a third carotenoid with novel properties. I have named this substance retinene.

Retinene in chloroform solution possesses no absorption bands in the visible spectrum. It is faintly yellow, due to an ascending absorption from 500 mμ into the ultra-violet. The crude retinal extract shows a small absorption maximum at about 410 mμ and larger ones at 310 and 280 mμ. Retinene exhibits a strong blue colour with antimony trichloride, due to a sharp band at 655 mμ.

Though present in quantity in the extracts of dark adapted retinas, retinene has completely vanished from light adapted ones. In these it has been replaced by about 0·3γ per retina (dry weight about 3 mgm.) of newly formed vitamin A.

The process which generates the vitamin is easily demonstrated in the isolated retina. Dark adapted retinas 'bleach' instantly in intense light to a bright orange colour (visual yellow). When such bleached retinas are immediately extracted with chloroform, they yield the same quantity of retinene as do dark adapted tissues, and no vitamin A. If, however, they are left at room temperature, the orange colour fades and within an hour has vanished. Extracts of such colourless retinas contain about 0·8γ per retina of vitamin A, and no retinene. Partially faded retinas yield intermediate quantities of both substances.

The fading of visual yellow proceeds equally well in light or in darkness, though in the latter instance some visual purple is regenerated. At 0° C. the process is delayed indefinitely, even in brilliant sunlight. The photochemical conversion of visual purple to visual yellow thus is followed by a thermal decomposition of the latter substance to colourless products, among them vitamin A.

Isolated retinas which have been bleached and have completely faded contain much more vitamin A than retinas from light adapted animals. Some vitamin A is therefore lost in the visual process.

Retinene is no more than a useful artefact in this system. It does not occur in the retina as a free substance. Benzine and carbon disulphide, though they dissolve both compounds easily, extract the vitamin A from dark adapted retinas, but no retinene. Subsequent extraction with chloroform yields retinene in the usual quantities. Neither carbon disulphide nor benzine affects visual purple or visual yellow, whereas chloroform rapidly decolourises both. Clearly vitamin A is bound in visual purple and yellow to some colourless molecule, insoluble in fat solvents. Chloroform breaks this complex to yield retinene. The thermal fading of visual yellow in the bleached retina dissociates the complex in another manner, liberating the vitamin.

Visual purple is non-diffusible[2] and may be salted quantitatively from solution with half-saturated ammonium sulphate. Its sensitivity to warming[2] and to deproteinating agents of all sorts adds a protein character to these general colloidal properties. The visual pigment seems, therefore, to be a carotenoid protein like that recently found by Kuhn and Lederer in lobster shells[3]. The lobster pigment and visual purple are similar in many properties; both are insoluble in water and organic solvents, and both are fundamentally altered by warming, acids, alkalis, alcohol and acetone. It is probable, therefore, that visual purple is a conjugated protein, in which vitamin A is the prosthetic group.

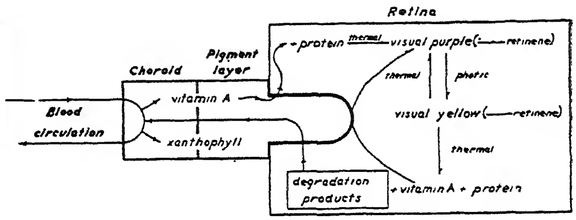

FIG. 1.

In isolated retinas which have been bleached and replaced in darkness, visual yellow reverts in part to visual purple; the remainder decomposes as described to colourless products. The latter substances never re-form visual purple in the isolated retina. In the intact eye this type of reversion does occur freely; it requires the co-operation of the pigment epithelium[2].

The pigment epithelium is necessary also as a source of vitamin A, quantities of which are lost during vision. These must be restored from the reserves in the pigment layer, since the frog retina contains no blood supply[4]. However, the ultimate source of vitamin A in any vertebrate is in the diet, and this is, at least in part, the reason for the failure of the visual purple mechanism (night blindness) in avitaminosis-A.

All these relations can be indicated in a single diagram (Fig. 1), which is tentatively proposed to represent the elements of visual purple-vision in the frog.

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[1] Wald, G., NATURE, **132**, 316, August 26, 1933.
[2] Kühne, W., "Hermanns Hdbch. der Physiol.", **3**/1, 235; Leipzig, 1879.
[3] Kuhn, R. and Lederer, E., *Ber.*, **66**, 488; 1933.
[4] Hyrtl, *Sitzber. Akad. Wien*, **43**, Abt. 1, 207; 1861.

Transpiration Current in Horsetails

THE xylem system of *Equisetum* appears so inadequate for the vigorous transpiration maintained, which may be twice as great as in the sunflower[1], that the suggestion has been made that water travels in the canal-system of the stem[2].

The following observations support this idea. I have constantly found, in the fertile shoots of *E. maximum*, that both carinal and vallecular canals and the large central lumen of the stem are filled with water under pressure. If an incision is made at the top of an internode a strong spurt of water escapes. This liquid has the following characteristics: pH 6·6, optically inactive, no reducing sugar present, no nitrate or nitrite, no amino acids, a trace of sulphate and a considerable amount of phosphate present. Evaporation leaves a fine, amorphous deposit, insoluble in ether.

When sporophore shoots are cut and left in water, even in a covered vessel, the upper internodes collapse laterally. On making an incision now there is a sharp intake of air, and the walls of the stem again expand. Transpirational loss being excluded by the conditions and direct leakage barred by the Casparian bands, there would seem to be a reversible secretion into these cavities from the surrounding parenchyma.

Similar observations have been made on *E. hiemale*. In both species observation with the binocular microscope shows the vallecular canals to be lined with turgid cells, here and there protruding like tyloses. Each end of a canal section and of an internodal lumen is covered with protruding, vesicular cells of secretory appearance, only distinguishable in living material. The pith lumen is lined with several layers of thin-walled cells, partly turgid, partly collapsed.

The reversed action after cutting, and the resorption of the secreted water, can only be due to the disappearance of the exudation pressure which originated from the roots. The phenomenon is an interesting complement to the development of a centripetal secretion pressure in normal roots and illustrates the upward extension of physiological root conditions in pteridophytic stems with typical secondary endodermis.

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June 6.

[1] Dosdall, *Plant World*, **22**, 1, 29; 1919.
[2] Westermaier, *Sitzber. Akad. Wissenschaften*, 1105; 1884.

Hatching Experiments on the Potato Eelworm (*Heterodera schachtii*)

DURING the course of our research on the potato eelworm (*H. schachtii*) we have established the fact that the root excretion of potatoes growing in recently sterilised soil does not possess the power of inducing hatching of eelworm eggs in the normal manner. In other words, we have found that when eelworm cysts are added to sterilised soil, the hatching of the eggs in these cysts does not commence for a considerable time afterwards although potatoes are growing in the soil. The period elapsing before hatching commences is greatest in very recently sterilised soil and gradually becomes less according as the interval between sterilisation and planting time is increased. This has been proved in the laboratory by hatching experiments (with large numbers of cysts) in which leachings from soil sterilised at different times and growing potatoes have been used. The effect of this delayed hatching is showing up very markedly in pot experiments. From our research it is obvious that, where hatching is delayed, the plants get a chance of making some growth and establishing a good root system before attack by the newly hatched larvæ. The onset of eelworm attack only when a good root system has been established does not seem to have much effect on the further growth or productivity of the plants.

In view of what we have found with sterilised soil, it appears reasonable to suggest that a somewhat similar condition of affairs may sometimes obtain in the field, where, due to one cause or another, plants make some growth and establish a good root system before the onset of eelworm attack. It appears that if hatching is delayed for even a short period after the plants commence to grow, the obvious symptoms of potato sickness do not develop to any extent.

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June 7.

Second Occurrence of the Whale-Shark (*Rhineodon typus*) in South Africa

IN April 1828 the first known specimen of the whale-shark was harpooned in Table Bay, and was described by Dr. Andrew Smith. Since then no other specimen had been reported from South African waters until one came ashore at Easter this year. It was found stranded on the sands at Kommetje Bay (on the west side of the Cape Peninsula) on April 2, but unfortunately was not reported to the Museum until three weeks later. The total length was 20 feet. Most of the skin of the upper half of the body, and also the head and fins were saved, from which it will be possible to investigate certain anatomical features which hitherto have been unknown or in need of verification. A description of these will appear later in the *Annals* of this Museum.

K. H. BARNARD.

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May 16.

The Australian Oyster

IN an abstract of my paper entitled "The Life History of the Australian Oyster, *Ostrea commercialis*"[1] an error was made in referring to the temperature of the water when oysters spawned at Port Macquarie, New South Wales. The temperature of 72°–76° F., given in the abstract as the spawning temperature, refers to that which prevailed for the most part during the six weeks prior to spawning. When the oysters actually spawned, the temperature of the water in contact with them was 68° F.; the water was two feet deep and the surface temperature was 70° F.

T. C. ROUGHLEY.

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April 27.

[1] NATURE, **133**, 332, March 3, 1934.

Research Items

Yurok Marriage. From an analysis of a large number of genealogies of the Yurok of the lower Klamath River, north-west California, Messrs. T. T. Waterman and A. L. Kroeber have compiled a marriage census, which reveals some interesting facts relating to their marriage system and incidentally affords an example of a mechanism by which a patrilineal culture might become converted to a matrilineal (*Univ. California, Pub. Amer. Archæol. and Ethnol.*, **35**, No. 1). Two types of marriage are recognised, 'full marriage' and 'half-marriage'. In the former the man 'pays' for his wife and takes her to live in his town and his house. In 'half-marriage', the man pays less, normally about half the value of his bride, and goes to live with his bride, either in her father's house or nearby. He is more or less under his father-in-law's direction and the children belong to his wife's family, their bride-price or any blood money going to his father-in-law, or in the event of his decease, to his wife's brothers. In 'full marriage' the children belong to the husband, and he retains them in the event of divorce, if he refuses to accept the refund of the marriage payment. 'Half-marriage' is perfectly legitimate and carries no disapprobation; but it indicates a lack of wealth and connotes a relatively low social standing in a society which equates wealth and rank. The census count shows about 23 per cent of marriages of the half-type, suggesting that either the plebs was small or that only part of it 'half-married'. In fact, it is clear that 'full marriage' was of greater frequency than the incidence of aristocracy. It is also evident that the influence of social status was sufficiently strong to lead to the avoidance of 'half-marriage' except from necessity. Mere economy was no adequate motive. In certain cases, however, wealthy parents without male children might persuade a son-in-law to live with them on condition that he became the heir, and a declaration making this clear accompanied the acceptance of the half-payment.

Some American Gobies. Mr. Isaac Ginsburg gives a detailed account of certain gobies, very common on the east coast of the United States as well as on the coast of the Gulf of Mexico, which are important members of the littoral marine fauna (*Bull. Bingham Ocean. Coll.*, **4**, Dec. 1933). In the genus *Gobiosoma* there are no scales (except for two scales at the base of the caudal fin in two sub-genera) and hitherto the common species have been separated into two only, according to the geographical range, one from the Atlantic coast of the United States and one from the Gulf Coast. It is here shown that several species are represented, three of which are common on the east coast of the United States, and their ranges overlap freely: *Gobiosoma ginsburgi* from Massachusetts to South Carolina, *G. bosci* (including *molestum*) from Long Island to Mexico, and *G. robustum* from Florida to Brazil. Closely related genera show a complete transition to the scaleless forms. Thus in *Aboma* the body is entirely covered with scales; in *Garmannia paradoxa*, the genotype, the scales are present only on the posterior half, from a line somewhat behind the origin of the second dorsal; in *Tigrigobius* (established originally as a sub-genus of *Gobiosoma*) the scales are still further reduced to a small patch on the caudal peduncle, and four scales on the caudal fin at its base (the four scales being also present in *Garmannia*); in *Gerhardinus* as well as *Dilepidion*, here regarded as sub-genera of *Gobiosoma*, the scales are reduced to two on the caudal fin at its base. A study of sex ratio in the commonest species shows that there is a preponderance of males in the catches, but, as is explained in the text, this may be due to the smaller size of the females.

Variation in American Fresh-water Gastropods. An intensive study of variation in *Goniobasis virginica* and *Ancula carinata* under natural conditions by Joshua L. Bailey, Jr., Raymond Pearl and Charles P. Winsor is published in three parts in *Biologia Generalis* (Band 8, Lief. 2 (Schlusslief.), 1932; Band 9, Lief. 2, 1933 and Band 9, 2 Hälfte (Verslugs-Festschrift), 1933). For this elaborate work two North American molluscs, closely related but belonging to distinct species, are chosen, both of which vary greatly under normal conditions in their natural habitats. The problem was to find the extent or degree of variation in both species in different defined localities within a small defined geographical region, and the relation between any local differences which may be discovered in these forms and measurable factors in the narrowly delimited local environment. The authors conclude that erosion is probably primarily physical, being caused by the silt particles carried by suspension in the water, and that the larger the snail the greater the erosion. Also that the size of the shells seems to be influenced by chlorine, but to a larger extent by the food supply, and that the silt in autumn tends to affect the size adversely, being finer at that time of year and lessening the growth of the algal food and also not being so effective a triturating agent in the stomach of the snail as are the larger sand particles deposited in the earlier part of the year.

Recent and Fossil Foraminifera. Both recent and fossil Foraminifera are dealt with in two of the latest parts of the "Discovery" reports (vol. 3, 1933, "Fossil Foraminifera from the Burdwood Bank and their Geological Significance" by W. A. Macfadgen and "Foraminifera, Part 2, South Georgia" by Arthur Earland). Mr. Earland continues the account of the recent forms. The first part having described the bottom deposits from the Falkland Islands and adjacent area, the present part is on those of the islands of South Georgia and the outlying Shag Rocks, situated some 800 miles to the eastward of the Falklands in the Southern Ocean. He finds the two areas very different although there is no great difference in latitude. South Georgia, lying outside the influence of the Pacific warm water and surrounded by the cold antarctic current flowing northwards, is within the region of the pack-ice, and rises more or less abruptly from deep water, the coastal deposits and bottom faunas being quite unlike those of the Falkland Islands. Many of the species in the coastal fauna are of a distinct type and several are new, while in the deeper water they are more or less identical with those at similar depths in all seas. The existence of really siliceous Foraminifera, except fossil forms, has always been a matter of uncertainty but is shown by Mr. Earland to be a fact, the author defining the term 'siliceous' as meaning "capable of resisting the action of strong acids

without structural change". Three of these acid resisting species have been found in the South Georgian material.

Guinea Worm in China. The occurrence of guinea worm, *Dracunculus medinensis*, in China, has apparently been reported only once, namely, in the tarsus of a horse in Tientsin in 1888, but as the horse had been brought from India it was uncertain where the worm had been acquired. In a recent issue of the *Chinese Medical Journal* (**47**, No. 11–12, 1933), dedicated to the memory of the late Prof. Fülleborn, H. F. Hsü and J. Y. C. Watt record observations on two dogs, both born in Peiping, which were found respectively in August and September 1933 to be harbouring guinea worm. In the first dog, which was one year old, four female worms were present, their anterior ends being observed respectively in the lower jaw, between the toes of the left fore foot, between the toes of the right fore foot and in the lower part of the left hind leg. The first of these worms was discharging larvæ. In the second dog, one year and one month old, one female worm, discharging larvæ, was present in the lower part of the left fore-leg. In Peiping the water of ponds and lakes is frozen from December until March and the authors therefore conclude that the development of sexual maturity in the worm requires at a minimum eight months and at a maximum one year. Four species of *Cyclops* were placed in dishes with actively moving larvæ from the female worms; the larvæ entered all four species. The authors had the intention of keeping the infected *Cyclops* alive for more than five weeks to permit the full development of the larvæ and to feed the infected *Cyclops* to dogs and in this way to complete the life-cycle, but the *Cyclops* died in less than five weeks.

Distribution of *Zostera*. R. W. Butcher has summarised (*J. Con. Internat. l'Explor. Mer.*, 9, 1934) the present condition and distribution of the various forms of *Zostera* on the English coast. Marked diminution of *Zostera* beds has been noticed for many years in certain localities and more particularly since 1918, that is, for many years before the disease was recorded in America. While in some places the plant has disappeared altogether, in others it is the large-leaved type-form of *Zostera marina*, L., which has suffered, and this has been replaced by narrow-leaved forms usually referred to as *Zostera marina*, var. *angustifolia*, Hornem. This form is sometimes considered to be *Zostera marina* × *nana*, but the author states there is no evidence of any of the chief taxonomic characters of *Z. nana* in such plants. In several places, where an epidemic was noticed in 1931 or 1932, the plants now seem to be recovering and healthy. No evidence of the cause of the disappearance of *Zostera* is produced, though the author suggests that a change in the nature of the substratum is one of the chief contributory factors.

Coal from the Lancashire Coalfield. The Fuel Research Board has just published No. 32 of its Survey Papers, containing a detailed report upon nineteen samples from seven distinct coal seams of the Lancashire coalfield. The seams are for the most part thin but variable, and all of them appear to consist of coking coals. It may be noted that considerable attention has been paid by the Research Board to the Lancashire coalfield, no less than seven reports on this field having been already published. The seams dealt with in this report have been in part dealt with in Report No. 19, which discusses the same seams in a different area of the coalfield. The work, as usual, has been done most carefully. The samples taken are in practically every case pillar samples cut from the seam *in situ* and representing it from the floor to the roof, and the report gives, in addition to the approximate and ultimate analyses of the coal, the amount of sulphur present, the calorific value, the melting point of the ash, the caking index and carbonisation assays, generally as obtained by means of the Gray-King apparatus. It may be pointed out that the seams dealt with in this report are all seams in the Lower Coal Measures and one even in the Millstone Grit. It is stated repeatedly in the report that the correlation of the seams offers considerable difficulty, but the method of using spores for correlation, although referred to in Paper No. 17 and recently applied advantageously by Dr. Raistrick in the Northumberland and Durham area, does not appear to have been employed in this report.

Map Projections. The presidential address of Dr. G. S. Adams, retiring president of the Philosophical Society of Washington, appears in the *Journal of the Washington Academy of Sciences* (**24**, No. 5, May 15, 1934). The principal map projections in common use are reviewed in this address and Dr. Adams describes a series of his own solutions to the problem of providing more accurate graticules for geodetic work. They are derived by projecting from the ellipsoid of revolution on to a sphere of equal surface and thence to a plane. The plane conformal projection is developed by means of the properties of the *sm w* elliptic function to give seven conformal graticules in various polygons. Cahill's butterfly map and its gnomonic variant are mentioned. The address ends with a brief account of the various co-ordinate systems devised and computed by the U.S.A. Geodetic Survey for linking cadastral surveys in the various States; these are based either on Lambert's conformal with two standard parallels or the transverse Mercator.

Wind Tunnel Interference Effects. A comprehensive survey of the interference effects of either the rigid walls of a closed tunnel, or the free surface of an open jet, upon models of aircraft wings, bodies, or airscrews has recently been published (Aeronautical Research Committee R. and M. No. 1566; "Wind Tunnel Interference on Wings, Bodies and Airscrews". By H. Glauert. Pp. 75+34 diagrams. London: H.M. Stationery Office, 1933. 4*s*. 6*d*. net). The effects are not only discussed but also the basis of the theoretical treatment is examined critically. Experimental results are quoted when necessary to justify formulæ used, or as a derivation of empirical values which sometimes have to serve to complete theoretical analysis. These are finally summed up in tables and figures which should be invaluable to users of wind tunnels for practical application of the correction formulæ. The limited extent of the artificial stream of a wind tunnel of either type inevitably leads to some constraint of the flow and to some interference with the behaviour of a model tested. This interference could be minimised by using very small models, but it is desirable for many reasons that the model should be as large as possible. One of the most important of these is the impossibility of faithful reproduction of detail construction to very small scales. The study of wind tunnel

interference is therefore of great importance. The application of the knowledge collected and collated in this report should extend the field of investigation available to all existing wind tunnels, and it must appeal to everyone concerned with the use of this particular instrument of aeronautical research. An extensive bibliography of relevant literature is included with references to the text as necessary.

Nuclear Transmutations with Heavy Hydrogen. Two papers on nuclear reactions produced by high-speed ions of heavy hydrogen have recently appeared (*Proc. Roy. Soc.*, A, May). In the paper by M. L. E. Oliphant, P. Harteck and Lord Rutherford, diplons (H^2 nuclei) are made to collide with diplogen nuclei (used as ND_4Cl and D_3PO_4), the velocities corresponding to a maximum of 400 kv. Experiment has revealed no action when D is bombarded with α-particles or protons. With the D bombardment, there was a large emission of particles falling equally into groups of ranges 14·3 cm. and 1·6 cm. The reaction assumed for this is

$$ {}_1D^2 + {}_1D^2 \rightarrow {}_2He^4 \rightarrow {}_1H^1 + {}_1H^3, $$

the ${}_1H^1$ and ${}_1H^3$ particles forming the two groups. There is furthermore a large emission of neutrons, apparently homogeneous in velocity, and ascribed to the reaction

$$ {}_1D^2 + {}_1D^2 \rightarrow {}_2He^4 \rightarrow {}_2He^3 + {}_0n^1. $$

The *Physical Review* for May 1 contains a letter from G. P. Harnwell, H. D. Smyth, S. N. Van Voorhis and J. B. H. Kuper in which the production of a hydrogen isotope of mass 3 by the first of these reactions has been confirmed by a mass-spectrograph analysis of a heavy hydrogen sample which had been exposed to a heavy discharge in a 50–80 kv. canal ray tube. (See also NATURE, **133**, 413, March 17; and **133**, 564, April 14, 1934.) J. D. Cockcroft and E. T. S. Walton (*Proc. Roy. Soc.*, A, May) describe the result of diplon bombardment of lithium, boron and carbon at voltages up to 700 kv. Lithium gives a proton group of 30·5 cm. range, which is ascribed to the reaction

$$ {}_3Li^6 + {}_1D^2 \rightarrow {}_3Li^7 + {}_1H^1 $$

the energy changes being roughly consistent with the known masses of the nuclei. Carbon gives protons with range 14 cm. (and probably γ-rays). Boron gives particles and several proton groups with ranges up to 92 cm., these being probably due to the conversion of B^{16} into B^{11}. Investigations on a number of heavy elements gave proton groups which were probably due to adsorbed layers of impurity.

Aluminosilicate Framework Structures. W. H. Taylor has recently given an account of the aluminosilicate framework structures which include the felspars, zeolites and other crystals (*Proc. Roy. Soc.*, A, June). In these structures the silicon and aluminium atoms lie at the centres of tetrahedra of oxygen atoms, and all the corner oxygen atoms are shared between tetrahedra. All the frameworks contain as a secondary unit a ring of four tetrahedra; most of the frameworks are three-dimensionally infinite, but in some zeolites it is probable that the framework is two-dimensionally infinite but of finite thickness. The framework constitutes an extended anion, and cations fitting into the framework may undergo isomorphous replacement of two types represented by $KSi \rightleftarrows BaAl$ and $Ba \rightleftarrows K_2$ respectively. The latter type of replacement is only possible when there are cavities within the structure to accommodate the increased number of potassium ions. The zeolites have peculiar properties of easy dehydration and rehydration—the tetrahedral framework is not dependent on the water molecules, but the latter fit beautifully into the framework if they are assumed to have the tetrahedral arrangement of bonds suggested by Bernal and Fowler.

Electrolytic Conductivity of Alkaline Earth Chlorides. Accurate measurements of the conductivities of some uni-univalent electrolytes have confirmed the Onsager conductance formula as a limiting equation. T. Shedlovsky and A. S. Brown (*J. Amer. Chem. Soc.*, May) describe experiments with the chlorides of magnesium, calcium, strontium and barium at concentrations (C) up to 0·1 normal. The results were considered in relation to the equation $\Lambda_0 = (\Lambda + \beta\sqrt{C})/(1 - \alpha\sqrt{C}) - BC$, where B, α and β are constants and Λ, Λ_0 are the equivalent conductances at concentration C and zero concentration, respectively. This equation reduces to Onsager's equation as a limiting form ($C \rightarrow 0$). The plot of the first term on the right (called Λ'_0) against C did not give perfectly straight lines, although the systematic deviations were not large, and the values of Λ_0 extrapolated agreed with those found by linear extrapolation from plots of Λ against $\sqrt{C}$ for measurements on the very dilute solutions. The data show that the equation for finite concentrations should be $\Lambda'_0 = \Lambda_0 + BC + DC \log C - EC^2$, in which D and E are constants. This result had been predicted theoretically by Onsager as the next approximation to the limiting law. The results thus confirm the Onsager equation as a limiting law for these electrolytes (bi-univalent). A relation with the sizes of the ions is also found.

Analysis of Stellar Variations. A new method of analysing stellar variability has been suggested by Prof. E. A. Milne (*Mon. Not. Roy. Astro. Soc.*, **94**, 418; 1934). Although intended originally to apply to pulsating variables of the Cepheid type, it promises to be of great value in the case of variable stars of all types. It is based on the theoretical relationship between radius (r), luminosity (L) and mass (M). In the case of any individual star, M is obviously constant, and if simultaneous observations of r and L are made, a characteristic curve may be plotted showing the relative variations of these quantities. Actually r and L are not observed directly, but r may be deduced from observed radial velocities by integrating with respect to time (after allowing for the velocity of the centre of gravity of the star and for the differing velocities of approach of different regions of the disc) if an approximate mean value of r is assumed. L is derived simply from radiometric observations. It is suggested that log r be plotted against log L, giving a characteristic curve which (in the case of regular periodic variables) will be a closed curve approaching the elliptical in form. Such curves give considerable insight into phase relations and the period-luminosity law. They also illustrate in a striking way certain features in pulsating variables, such as the coincidence of maximum L with maximum surface velocity. Some preliminary applications are made by the author, sufficient to show its possibilities in increasing our understanding of the nature and origin of stellar variation.

Position of Caste in India

AN instructive review of a situation difficult to gauge with detachment was prepared by Sir Claude Hill for the Friday evening discourse on "Society and Caste in the India of To-day" which was to have been delivered at the Royal Institution on March 9. The discourse was never delivered, for Sir Claude was taken ill and died on April 20, but it is now available in the *Proceedings of the Royal Institution*, vol. 28, pt. 2, p. 251. It is generally admitted that the present reaction of Hinduism to the introduction of Western conditions and ideas and its effect on the future of the caste system is one of the most important, and at the same time obscure, factors in the Indian political situation.

Sir Claude, in his preliminary account of the origin and characteristic features of caste, lays stress on the fact that this system, imposed for the preservation of the racial purity of the invading Aryans—a function which he aptly compares with that of the restrictions laid by Moses on the Israelites—notwithstanding efforts at reform such as Buddhism, Brahmo Samaj and other movements which he mentions, has adhered rigidly to its main purpose in the demarcation of the grades of society and the regulation of their intercourse. He refers more particularly to two examples which show the strength of caste feeling as against considerations which in other circumstances might be expected to carry preponderant weight. Of these, one is the remarkable position of the Chitpávan Brahmins, who, although they are said to have originated from castaways on the west coast, a tradition supported by their physical characters, have attained a dominant position in Brahminism on the strength of their claim to have sprung from the head of Brahma. The second instance is that of Mr. Gandhi, who, not being a Brahmin, but a Banya by caste, after attaining a position of pre-eminence in leadership such as has not been known for centuries, lost influence entirely when he took up the cause of the Untouchables, not as a political measure, but as an attack on the caste system.

There is, Sir Claude goes on to point out, a curious paradox in modern India. Young India, the intelligentsia class, has imbibed the democratic ideas of John Stuart Mill and Marx, yet clings with an almost fantastic tenacity to the ancient garment of Hindu social philosophy. Superficially, the West has made its mark on the face of Indian society. Sir Claude, in common with other observers, noted the marriages into higher and lower castes or even outside the pale of caste, the ignoring of caste in travel on railways and other like unwelcome departures from 'the ordained path'; but he holds that it would be a mistake to regard these incidents as portending any fundamental change of outlook on the part of the overwhelming mass of the people.

Sir Claude very rightly points to the unchanged position of the village Brahmin, upon whom in the rural community, who form 90 per cent of the population, Hindus of every caste depend for the ceremonial observances which accompany every stage of their life from the cradle to the grave. The undoubted revolt against Brahminical dominance is, he maintains, entirely confined to the political arena, but in the social field the situation remains substantially the same.

On the other hand, while emphasising the extent to which the Indian political problem during the past four years has been complicated by the caste system, Sir Claude also stresses the fact that many highly cultured Brahmins in various parts of India are making noble efforts for social reform by endeavouring to modernise traditional prejudices. Social reform is being advocated by all grades of Indian society, but the leaven is working slowly, especially when compared with the rate of political change. In summing up the position, Sir Claude was of opinion that contact with the outside world will in course of time produce a transformation, but that in so far as we of the Western world are concerned, our help will best be given by an attitude of sympathetic understanding.

International Universities Conference at Oxford

THE Association of University Teachers took the initiative in convening an International Conference of university representatives which took place at University College, Oxford, on June 29–July 2. The conference was called for the discussion of general problems of university organisation and development in the light of the experience of different countries and it was, so far as is known, the first definite effort to establish some measure of international association between universities for the specific purpose of considering university affairs.

Forty universities abroad and in the Dominions appointed delegates to attend the Conference, as well as certain university associations, while British universities were represented by the Council members of the Association of University Teachers and by delegates from Oxford, Scotland and the British Federation of University Women. It was gratifying to observe that among the foreign representatives were included the presidents of both the French and the German University Federations and the vice-president of the Association of American Professors.

The proceedings began with a dinner in University College on June 29, at which the foreign delegates and those of Oxford, Sir Michael Sadler and Mr. George Smith with the Warden of All Souls College, were the guests of the Council of the Association of University Teachers.

The first day of the Conference was devoted to a series of accounts of the origin, constitution and aims of the university associations which already exist, given by representatives of each association. These included associations in England, Scotland, France, Germany, the United States, Hungary, Switzerland and Mysore; but the Swedish and Italian associations unfortunately could not be represented.

It is evident that the principle of association between teachers in universities is of recent origin and has not yet spread far, but in each of the cases mentioned the existing associations are flourishing and useful institutions, keenly appreciated by their members. It is to be hoped that the publication of this series of reports may do something to encourage the foundation of similar associations elsewhere.

On the second day the Conference divided into four commissions, dealing respectively with: (1) overcrowding in universities; (2) vocational training in universities; (3) co-ordination of the machinery

of interchange of teachers; (4) adult education in the universities. Reports from these sections were presented by the sectional leaders to the Conference for discussion on the last morning.

In general, it may be said that there was abundant evidence of interest in the very varied experiences and opinions revealed in these informal discussions. At a first conference the procedure must obviously be exploratory, but nevertheless there was a movement to set on foot international committees to deal with both of the questions, overcrowding and exchange, in which concerted action seems to be specially indicated.

These committees were not actually instituted by the present Conference, which felt that the ground should be explored further with fuller material in hand before action is taken. In order to prepare for this, the Conference resolved that an International Conference Committee should be instituted and that the university associations in each country, or single national universities where such exist, or *ad hoc* committees in other countries, be invited to nominate an officer to act as a member of this committee, the duty of which will be to maintain international contacts and prepare material for future conferences. Prof. R. C. McLean of University College, Cardiff, was appointed by the Conference to act as secretary of this committee.

The Conference then agreed to accept provisional invitations from France for 1935 and from Germany for 1936 as the scenes of the next two Conferences.

The Warden and fellows of All Souls gave an evening reception at which the Vice-Chancellor, who was unavoidably absent from Oxford, was represented by the Right Hon. H. A. L. Fisher, the Master of New College. The Conference was concluded by an address from Prof. Gilbert Murray, in which he emphasised the duty of university people to uphold ethical standards and freedom in the pursuit of truth.

The movement thus initiated promises well for the future co-operation between universities in different lands, and it is greatly to be hoped that these periodical conferences will establish themselves as a permanent and valuable feature of international organisation.

Sixteenth International Congress of Agriculture

THE sixteenth International Congress of Agriculture was held at Budapest on June 13–20 under the presidency of the Marquis de Vogüé, president of the International Commission of Agriculture, and was attended by about 1,100 members. The fifteenth Congress had taken place at Prague in June 1931 and the fourteenth at Bucharest in 1929, it having been the intention up to the present to convene such gatherings every two years. Actually ten meetings took place prior to the War, and a further six have taken place since. The seat of the international organising committee is at Paris where the inaugural meeting was held in 1895, to be followed by a second (which actually, however, must rank as the first proper) meeting at Budapest in 1896, which year marked the thousandth anniversary of the existence of Hungary as a nation.

Consequently, after an interval of thirty-eight years, Budapest has been once more chosen as the venue for the Congress. At the preceding one, held at Prague, attention was focused on the then most pressing problem of the moment, namely, the agricultural crisis and methods to be recommended for combating it and minimising its evil effects. The programme of work at the recent Congress was subdivided into eight sections, namely, (1) agricultural economics, (2) rural education, (3) co-operation, (4) crop production, (5) viticulture, (6) live-stock production, (7) agricultural industries and (8) consideration of the part played by women in the farming community and in farming life.

The principal paper in section 1 was that by Prof. Ernest Laur, director of the Union suisse des paysans, on the reorganisation of present-day agriculture and, in view of the persistence of the agricultural depression in almost all countries of the world as well as the severity of its incidence, the subject of his contribution must be considered as the principal and most important topic discussed at this Congress. Prof. Laur, at the conclusion of his paper, put forward various recommendations, forming part of a proposed agricultural policy, amongst which were that the consumption of fats of animal origin, and especially butter, should be encouraged by private or State measures in order to combat the growing consumption of vegetable fats, which in turn has restricted the consumption of cereals and been one of the principal causes of the accumulation of cereal stocks with resulting price debasement.

The other papers in section 1 dealt with the influence of mechanisation on agriculture and with the organisation of a proposed international live-stock market.

At the Prague Congress the attendance was about 1,200, including 563 participants from European countries other than Czecho-Slovakia and from non-European countries, and this total represented the highest attendance reached at any meeting held up to date. The Budapest Congress showed an attendance of 72 official delegates of various Governments, 19 delegates representing international organisations, and about 1,028 individual members. Great Britain was only represented by some fifteen of the latter and such a poor representation is, in the opinion of the writer of this article, very much to be regretted, the more especially as the same state of affairs prevailed at the two previous congresses at Bucharest and Prague.

Most of the countries taking part in these congresses are, in the main, agricultural exporting countries, whereas England is, as is well known, a heavy importer of agricultural produce. In order therefore that her views and difficulties as such should be properly stated and justified, it is essential that she should be adequately represented at these international congresses, which assume more and more importance as time goes on. Failure to do so is liable to result in judgment going by default.

At the termination of the Congress a choice of agricultural excursions was offered to all members, that to the Hungarian university town of Szeged and to the Government stud farm at Mezőhegyes being of especial interest.

At the closing session the Congress resolved that from now onwards meetings should be held at intervals of three instead of two years, as previously intended, and that the venue for the next congress should not be decided until next year.

Association of Technical Institutions

PAPERS read before the annual summer meeting of the Association of Technical Institutions, held at Brighton on June 22–23, included "Apprenticeship and the Irish Apprenticeship Act", by Mr. R. R. Butler, of the Aston Technical College; "National Scheme of Foundry Education", by Mr. J. G. Pearce, director of the British Cast Iron Research Association; and "The Function and Operation of Junior Instruction Centres", by Mr. Valentine A. Bell. Mr. Bell's paper insisted that the work of the Juvenile Instruction Centres has consistently followed the general purpose of preventing "demoralisation likely to result from unemployment" and "facilitating the absorption of boys and girls into employment as soon as opportunity may occur". Mr. Bell, who has visited these centres in various parts of the country, dealt with criticism levelled against them. He did not fail to stress difficulties such as those of staff recruitment (since "there was no guarantee as to how long the centres would remain open, it was difficult to find men who had permanent jobs to take up this new work"), but his answer to the criticism so often made, namely, little good can be done where the average length of stay per student is only three weeks, is to the point: "Those who merely study statistics are easily inveigled into making rash statements. . . . I may have had 10,000 through my Centre during the past four years. Thousands may have found work within a week, but hundreds have stayed with me for six months or more, yet the average may work out at only four weeks."

Very closely allied to Mr. Bell's paper was an address given by Mr. F. N. Tribe, of the Ministry of Labour, who dealt with the educational provisions of the Unemployment Bill. He pointed out that the Royal Commission on Unemployment Insurance recommended that the gap between the school-leaving age and the age of entry into insurance should be bridged by lowering the age of entry into unemployment insurance to correspond with the statutory school-leaving age. The recommendation avoided any stereotyping of age fourteen years as the proper age for leaving and suggested that contributions should be credited in respect of voluntary full-time education, and that attendance at a course of instruction should be a normal condition for the receipt of benefit by anyone less than eighteen years of age. These conditions have been accepted by the Government.

Mr. R. R. Butler indicated that while laws governing apprenticeship are in operation in Germany, Denmark, Hungary, South Africa, New Zealand, Ontario and the Irish Free State, no similar national system has been considered desirable in England. It is clear that, under rationalised conditions in industry, it is no longer possible for a master craftsman to educate his apprentice. Under conditions of mechanisation, the duties of apprenticeship fall increasingly on technical colleges. He urged an increase in full- and part-time day technical colleges and an extension of the junior trade schools on a national basis. These steps become the more necessary if, in England, we are not prepared, like the Irish Free State (Act of 1931) to adopt a legal system of apprenticeship. In any scheme, however, training for specialised jobs will be of less importance than training for adaptability to changing processes.

Mr. J. G. Pearce also underlined the importance of adaptability of mind and the power to reason correctly about the new facts and circumstances which are continually arising. The old distinction between the man of theory and the man of practice, he said, is fast disappearing. He went on to describe a national scheme of education for the founding industry. A school for training those who have already experience in the industry to be managers, foundry engineers, chemists and metallurgists is to be opened at Birmingham Central Technical College in October 1935 if sufficient students are forthcoming.

Annual Conference of the Museums Association

THE forty-fifth annual Conference of the Museums Association was held at Bristol on July 2–7, by invitation of the Lord Mayor and Corporation. The meetings were held in the Museum and Art Gallery, but the University authorities very kindly granted the delegates additional facilities. The Conference was very well attended and some two hundred and thirty members of the Association met under the presidency of Dr. Cyril Fox, director of the National Museum of Wales.

In his presidential address, Dr. Fox, in the first place, dealt with the progress of the Association during the year and the great developments at home and in the Dominions due to the generosity of the Carnegie Corporation of New York and the Carnegie Trust in Great Britain. He commented also on the firm and practical basis upon which the diploma scheme and the educational policy of the Association now rest. The main part of his address, however, was occupied by a plea for a National Folk Museum in Great Britain. After describing a typical Continental open-air museum (that of Skansen, Stockholm) he emphasised its advantages and cultural effect. Dr. Fox also stressed the additional establishment of regional open-air museums to illustrate local aspects of general culture. He urged provincial curators to collect in the meantime the fast-disappearing furnishings and implements of local interest.

Following the presidential address, Dr. R. E. M. Wheeler opened a discussion on folk museums, in which he divulged that the Departmental Committee, set up according to the recommendations of the Royal Commission on National Museums and Galleries, has come to the conclusion that the National Folk Museum should be in London, about 10–15 acres in size, and should consist of a museum containing folk-material and an open-air coherent village-group illustrative of English country life before the Industrial Revolution.

In the afternoon Mr. J. E. Barton interested and amused the delegates with a paper on "The Education of Public Taste" and Mr. H. W. Maxwell described the steps that have been taken during his directorship to modernise the Bristol Museum and Art Gallery.

The whole of Wednesday morning was devoted to more scientific subjects. Dr. F. S. Wallis, speaking on "The Popularisation of Geology", suggested simpler labelling, more life-reconstructions of extinct animals, and less truly systematic arrangement of specimens. Dr. F. J. North gave an excellent account of map making and the importance of map collections, especially those of the middle and later part of last century. Prof. A. E. Trueman, of Bristol, wound up the morning with a paper on "Science and the Public Museum" in which he urged a greater curatorial interest in working things illustrating the physical sciences, especially astronomy. This paper was much appreciated and evoked a good discussion which seemed to indicate that quite a number of delegates have little knowledge of recent improvements in science museums.

Thursday morning was occupied by the annual general meeting, but afterwards seven members of a delegation of the Association to the recent American Museums Conference at Toronto gave their impressions gained upon the tour. They were informative and entertaining, and showed a respect for much American museum technique and even for such diverse things as American petrol stations and cemeteries. In the afternoon the delegates were conducted round the various University departmental museums by their honorary curators.

The morning of the last day was devoted to short papers by Prof. L. P. W. Renouf, of Cork, on "Stamps as Educational Exhibits", by Mr. Percy Grimshaw, of the Royal Scottish Museum, on the newly-arranged Children's Gallery in that Museum, and by an excellent demonstration by the Gaumont British Film Company of the uses of the cinema in the museum. All the meetings were well attended though there was probably less general discussion this year than is usual. It only needs to be added that there was a full trade exhibition staged in the Royal West of England Academy. Dr. Cyril Fox was re-elected president of the Association, and it was decided to accept the Belgian Government's kind invitation to hold the next conference in Brussels.

University and Educational Intelligence

LONDON.—The Court has accepted a tender of £362,579 from Messrs. Holland and Hannen and Cubitts, Ltd., for the superstructure of the first of the buildings to be erected on the University's site in Bloomsbury. A condition of the contract will be the use throughout of materials obtained from sources within the British Empire. The date for completion is March 25, 1936.

ST. ANDREWS.—The Court has appointed Dr. A. M. Taylor to be lecturer in natural philosophy, and Mr. R. Jackson to be lecturer in philosophy, in the United College.

The Sir Henry Jones Memorial Committee has offered to the University a sum of about £100 to provide annual prizes in the Department of Moral and Political Philosophy. Prof. Henry Jones held the chair of logic and metaphysics from 1891 until 1894.

The degree of D.Sc has been conferred upon R. C. Menzies for a thesis on the application of thallium compounds in organic chemistry, and upon James Stirling for a thesis entitled "A Study of Flowering in Heterostyled and Allied Species".

THE following awards for the year 1934–35 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Salters' Company:—Fellowships have been renewed to:—J. D. Rose, of Jesus College, Oxford; C. W. Woolgar, of King's College, London. Fellowships have been awarded to:—G. Broughton, of East London College; D. E. Wheeler, of the University of Bristol; L. R. Barrett, of Lincoln College, Oxford. The Salters' Institute has also awarded one hundred and thirty-six grants-in-aid to young men and women employed in chemical works to facilitate their further studies.

THE Science Scholarships Committee of the Royal Commission for the Exhibition of 1851 has made the following appointments to Overseas Scholarships for 1934 on the recommendation of the institutions named: *Canada.* McGill University, Montreal: Dr. E. Solomon, for research in physical chemistry at the University of Manchester, and Dr. A. H. Snell, for research in physics at the University of California. Queen's University, Kingston: Mr. W. E. Bennett, for research in physics at the University of Cambridge. University of Toronto: Dr. L. B. Pett, for research in biochemistry at the National Institute for Medical Research, London. *Australia.* University of Adelaide: Mr. L. A. T. Ballard, for research in plant physiology at the University of Cambridge. University of Melbourne: Mr. L. H. Smith, for research in organic chemistry at the University of Oxford, and Mr. D. P. R. Petrie, for research in physics at the University of Cambridge. *New Zealand.* University of New Zealand: Mr. H. Service, for research in geology at the Imperial College of Science and Technology, London. *Irish Free State.* University of Dublin: Joyce C. Hill, for research in zoology at the Strangeways Research Laboratory, Cambridge.

Science News a Century Ago

The Obelisk of Luxor

In the *Mechanics Magazine* of July 12 and 19, 1834, is an interesting account of the arrangements made for the transport to France from Egypt, a country "once great and flourishing, but now desolate and forsaken", of the famous Obelisk of Luxor. The plans for its transport were entrusted to the distinguished naval engineer, Jean Baptiste Lebas (1797–1873), who had been a student at the Ecole Polytechnique. Under his direction a special vessel was built at Toulon, the crew of which consisted of 120 seamen and 12 artisans. Commanded by Lieut. Verniac, the vessel sailed from Toulon on April 15, 1831, arrived at Alexandria on May 3 and proceeding up the Nile, reached Luxor on July 12, when her rigging and fittings were removed. With her stern ashore, as the waters subsided she settled in the sand and sand was piled high around her sides. A section of the stern was then removed and an inclined plane was constructed to the Temple 1,500 ft. away. The obelisk was then encased in a wooden shell, one side of which was worked smooth and greased, and by means of a number of tackles and capstans the obelisk, weighing about 240 tons, was slowly lowered and drawn down the inclined plane and placed in the ship. These operations were completed by December 19, when the vessel was released from the sand and re-rigged, and on December 25 proceeded down the river. The obelisk was set up in the Place de la Concorde, Paris, by Lebas in 1836.

Karl Ludwig Harding, 1775–1834

On July 15, 1834, at Göttingen, the death occurred of Karl Ludwig Harding, whose name will always be remembered in connexion with the search for a planet between Mars and Jupiter, which led to the discovery of the asteroids. Born at Bremen in 1775, Harding was working under Schröter, "the Herschel of Germany", at Lilienthal when through the efforts of von Zach an association of twenty-four astronomers, mostly German, was formed for the search for the unknown planet. The honour of finding the first asteroid, Ceres, fell to Piazzi at Palermo on January 1, 1801, while the second, Pallas, was first seen by Olbers at Bremen on March 28, 1802. Two and a half years later, on September 2, 1804, the third, Juno, was discovered by Harding. The finding of these small planets aroused immense interest and Harding was awarded the Lalande Medal by the Paris Academy of Sciences. About the same time he was appointed professor of astronomy and director of the observatory in the University of Göttingen, where for many years Gauss was his colleague. An interesting episode in his career was recalled in NATURE of July 19, 1877, p. 237, in a reference to letters which had passed between Gauss and Laplace in 1807 when the professors at Göttingen had had to make contributions to the French Army occupying the town.

Prout and the Atomic Theory

When Francis Henry Egerton, eighth Earl of Bridgewater (1756–1829), died, he left £8,000 to be given to the author or authors, appointed by the president of the Royal Society, who should write an essay "On the Power, Wisdom, and Goodness of God, as manifested in the Creation". The writing of the essays was entrusted respectively to Sir Charles Bell, Drs. Chalmers, Kidd, Buckland, Roget and Prout and the Revs. William Whewell and William Kirby. The essays were published in 1833–35. In some cases they led to much controversy, and that by Dr. William Prout (1783–1850) on chemistry led Dr. W. C. Henry to criticise his views in the *Philosophical Magazine*. In reply to these remarks, Prout, writing from his house in Sackville Street, Piccadilly, on July 18, 1834, to the editor of the *Magazine*, said that he anticipated his opinions would provoke discussion, but that he had no time or inclination to enter into a controversy. "I have always," he said, "adopted the fundamental principle of atomic weights, or definite proportions, established by Dr. Dalton, and have always reflected with pride that this most important doctrine was first taught by an Englishman; but that I never did adopt, and I fear, never shall be able to adopt, some of the details of his atomic theory. Indeed I have always considered the atomic theory, as explained by Dr. Dalton, far less satisfactory and complete, as a whole, than his theory of gaseous bodies and of vapours; which had he done nothing else, would have placed him at the head of modern physical inquirers in this, and in every other country."

Chimneys and Chimney-Sweeping

Among the many social questions engaging attention a century ago was the wretched condition of young children employed on sweeping chimneys. In a Bill for the Better Regulation of Chimney-Sweepers and the Safer Construction of Chimneys and Flues discussed in Parliament in 1834, it was laid down that chimneys not being circular of 12 in. diameter should be not less than 14 in. by 9 in. with no angles less obtuse than 120°, and that partitions in chimneys and flues should be at least half a brick thick with joints well filled with mortar or cement. Commenting on this Bill, the *Mechanics Magazine* of July 19 said: "Should the bill, with these enactments pass into a law, something will certainly be gained to the cause of humanity, but it seems to us, notwithstanding, to be conceived altogether in a very petty spirit of legislation. The shortest, and at the same time, the only effectual way to put an end to the stifling and burning of infants in chimneys, is to prohibit absolutely and entirely the sweeping of chimneys by infants." Some years, however, passed until the age of chimney-sweepers' apprentices was raised to sixteen years, and after 1842 no one of less than twenty-one years of age was allowed to be employed on this work. The invention of the chimney-sweeping machine, which did away with the need of a person climbing the chimney, was the work of the philanthropist, Joseph Glass (1791 ?–1867), and was never patented.

Societies and Academies

LONDON

Physical Society, June 15. R. L. SMITH-ROSE and J. S. MCPETRIE: Measurement of the electrical constants of soil by a Lecher-wire method at a wave-length of 1·5 m. A parallel Lecher-wire system was set up and coupled to a source of oscillations of the desired frequency. The length of the stationary waves set up on the wires in air was measured and compared with the corresponding wave-length when the wires were immersed in the sample of soil under examination. The ratio of these wave-lengths gives directly a quantity involving both the conductivity and the dielectric constant of the soil. For conditions of normal moisture content the dielectric constant is 10 or 12, while the conductivity lies within the range $10–28 \times 10^6$ E.S.U. J. S. MCPETRIE: A determination of the electrical constants of the earth's surface at wave-lengths of 1·5 and 0·46 m. The most sensitive condition for finding the electrical constants of a substance from a study of its reflecting properties for electromagnetic waves is obtained when the radiation is incident normally on the reflector. The experiments described show that in this case the reflection coefficient of copper gauze is practically unity at both wave-lengths. There appears to be little difference in the reflecting properties of ordinary soil and soil covered by grass, probably because the bulk of the reflection takes place at a small distance below the surface. O. DARBYSHIRE: (1) A spectrometer determination of the metrical thickness and dispersive power of a thin film. By counting the numbers of Edser–Butler and Talbot bands produced within the same spectral range by a thin film of glass and a prism spectrometer, the metrical thickness of the film can be determined. The refractive index of the film for light of any standard wave-length can then be calculated from a count of the number of Talbot bands passing the position of the corresponding line in the spectrum as the Talbot echelon is rotated about the vertical edge of the film through an accurately measured angle. Two spectrometers are used in conjunction as a double-table spectrometer, and the other apparatus required is of the usual student-laboratory type. (2) Application of the theory of

the transmitting echelon to the explanation of Talbot's and Powell's bands. On the basis of the theory of the transmitting echelon, the formation and the asymmetrical character of Talbot's bands, which are produced when a plate and aperture are placed in certain positions in the beam of a prism spectroscope, are explained analytically and represented diagrammatically. R. W. POWELL: The thermal and electrical conductivity of metals and alloys: (1) Iron from 0° to 800° C. A longitudinal-flow method has been used to determine the thermal conductivity, at mean temperatures ranging from 30° to 800° C., of a nickel-plated rod of Armco iron containing approximately 99·92 per cent of iron. After allowance for the effect of the nickel plating, and extrapolation to 0° C., a value of 0·177 C.G.S. units is obtained for the thermal conductivity of the iron. This value is higher than that usually attributed to iron, but a chemically prepared iron of greater purity has been examined also and found to have a thermal conductivity of 0·194 C.G.S. units at 0° C.

DUBLIN

Royal Irish Academy, May 28. A. FARRINGTON: Glaciation of the Wicklow Mountains. Two local glaciations occurred in the area. The first was an ice cap and was earlier than the last Ivernian ice-sheet, while the second was a valley glaciation and was later than the last Ivernian maximum. Modifications in the accepted edge of the Ivernian ice sheet are suggested; and, from the distribution of the local ice of the last phase, it is inferred that the direction of the prevailing wind was about the same as at present. The height of the snow-line of late glacial times was discussed.

PARIS

Academy of Sciences, May 23 (*C.R.*, 198, 1821–1888). P. A. DANGEARD: Notice on the work of the late Robert Chodat. GABRIEL BERTRAND and R. C. BHATTACHERJEE: The combined action of zinc and vitamins in the nutrition of animals. Results of experiments showing that vitamins cannot exert their normal action in the absence of zinc. JEAN BAPTISTE SENDERENS: The action of sulphuric acid, cold or at a moderate temperature, on the aromatic esters. From the point of view of sulphonation, sulphuric acid acts upon aromatic esters and acids similarly. E. GUYÉNOT, MLLES. K. PONSE and I. TROLLIET: The masculinising action of urine from the pregnant woman. LÉON POMEY: Unicursal involutions of the fourth order. ELISHA NETANJAHU: The term and the maximum modulus of Dirichlet's series. R. SAN JUAN: The problem of moments. EDMOND LAHAYE: A method of resolution of a category of transcendental equations. B. EDLÉN and P. SWINGS: The prohibited transitions of atoms with electronic configurations $2s^22p^2$, $2s^22p^3$, $2s^22p^4$, and on the interpretation of the lines of nebulæ and novæ. GEORGES POIVILLIERS: The perspective property of certain surfaces and its application to aerial phototopographic surveys. Discussion of certain cases in which distortion may arise in the course of stereotopographic surveys. AUREL POTOP: Natural convection is a very well defined phenomenon. Study of the heat loss from a small electric furnace. In the case of a furnace dissipating 0·5 watt, experiments can be repeated with an accuracy of one in five thousand. JEAN BECQUEREL, W. J. DE HAAS and J. VAN DEN HANDEL: The paramagnetic rotatory power of dysprosium ethylsulphate at very low temperatures. The experiments described represent the first case known of paramagnetic saturation. ALBERT LAMBRECHTS: The spectrographic study of phlorhizine and its derivatives. The ultra-violet spectrum of phloretine, phlorine and phloroglucinol. MLLE. SUZANNE VEIL: The systematic examination of the periodicities of precipitation by the two drop method. MLLE. M. QUINTIN: The heat of dilution of salts. The heat of dilution of copper sulphate solution has been determined by measurements of E.M.F. and application of the Gibbs-Helmholtz formula. JACQUES LEFOL: Hydrated calcium sulphoaluminate and calcium chloroaluminate. PIERRE VALLET: A recording apparatus for the study of reactions with regularly varying temperatures. This apparatus records simultaneously the variations of mass of a substance as a function of its temperature and the variations of its temperature as a function of the time on the same plate. R. SUTRA: The degradation of starch under the action of phosphoric acid, of glycerol and of acetic anhydride in the presence of sulphuric acid (acetolysis). JOSEPH HOCH: The action of organomagnesium compounds on ketoxims. L. ROYER: The structural relations which should exist between two substances *A* and *B* for *B* to modify the facies of crystals of *A*. New examples. PAUL LEMOINE, R. HUMERY and R. SOYER: The impoverishment of the stratum of green sand of the Paris region. The effects of the increase in the number of wells drawing water from the green sand. In ninety-three years the water level has been lowered 93 metres in the Seine synclinal. MIECZYSLAW PRONER: Researches on the idioblasts in the family Crassulaceæ. MAX VACHON: The act of nutrition of a pseudoscorpionid, *Chelifer cancroides*. PAUL CHABANAUD: The basisphenoidian complex and the nadiral orbital septum of the heterosome fishes. EMILE HAAS: A method for locating the retinal impressions with respect to the fovea. Application to the study of acuteness of vision at low illuminations. R. BONNET: The neuro-muscular action of amides and cyanic derivatives. From a pharmacodynamical point of view, urea behaves as an amide and not as a cyanic derivative: this is not in agreement with the Werner formula for urea. JACQUES MONOD: Galvanotropism and physiological age. MAURICE DOLADILHE: New observations on the physical properties of blood serum.

SYDNEY

Royal Society of New South Wales, December 6. A. R. PENFOLD and F. R. MORRISON: The essential oils of the genus *Calythrix*. (1) *Calythrix virgata*. The essential oils from various consignments were obtained in a yield of 0·5 per cent and possessed a very pleasant Tea Rose odour. The essential oil was found to contain *d*-*a*-pinene, citronellol and geraniol both free and combined as acetic, formic, citronellic and dehydrocitronellic acid esters. The range of chemical and physical constants of the essential oil was determined. M. B. WELCH: Some mechanical properties of Alpine ash. (1) *Eucalyptus Delegatensis*, R.T.B. (1) There is no uniform increase in strength towards the top of the tree, and in some instances the wood is decidedly weaker in the uppermost log than in the lowest. The weight per cubic foot varies from 32 lb. to 46 lb. and except for wood of low density it possesses considerable strength with a high modulus of elasticity, whilst the toughness, as indicated by the work to the maximum load, and also the elastic resilience, is

very satisfactory. The fibre stress at the proportional limit, modulus of rupture and modulus of elasticity increase comparatively regularly with the density, but the effect of density is more irregular on the work to the proportional limit and to the maximum load. J. C. EARL and A. W. MACKNEY: The action of nitrous acids on dimethylaniline (2). The substance described previously (*J. Proc. Roy. Soc. N.S.W.*, 67, 231; 1933) as the principal product from the reaction in the absence of strong acids, has now been identified as *p*-nitroso-dimethylaniline nitrate. It is difficult to obtain correct values in the estimation of nitrogen in this compound. F. P. DWYER and D. P. MELLOR: X-ray diffraction studies of the crystallisation of amorphous silica. X-ray powder photographs show that, as a result of the crystallisation of amorphous silica or opal in the presence of molten potassium chloride below 870° C., cristobalite is the first crystalline modification of silica produced. The occurrence of cristobalite as a form intermediate between amorphous silica and tridymite thus brings these transformations into line with Ostwald's principle. Cristobalite produced by heating silica gel and opal with potassium chloride at 810° C. was found to persist in the (β) high form for several months and eventually appeared to invert to (α) low tridymite. The formation of cristobalite from vitreous silica is consistent with the crystallite theory of the glassy state put forward by Randall and Rooksby. ADOLPH BOLLIGER: Volumetric micro-determination of perchlorates with methylene blue and picric acid. Perchlorates form, with methylene blue, a methylene blue perchlorate which is only slightly water soluble. By adding a known excessive amount of methylene blue the excess can be determined by titration against standardised picric acid. Complete removal of the methylene blue perchlorate formed is necessary with small amounts of perchlorate exceeding 1 mgm. A double precipitation method may be used whereby the excess of the methylene blue added is precipitated with an excess of picric acid. After filtering off the combined precipitates the remaining excess of picric acid is determined by titration with methylene blue. R. J. NOBLE: Note on the longevity of spores of the fungus *Urocystis tritici*, Koern. Chlamydospores were exposed to a series of relative humidities at 13°–31° C. for ten years. During the first two years, germination was first observed on the 50 and 64 per cent relative humidity series. No germinations were recorded at 72 per cent or 89 per cent at any time. Viability was lost at 64 per cent relative humidity after 2 years and at 50 per cent after 6 years. More than 50 per cent germination has been recorded in the 0–33·5 per cent relative humidity series each year.

Forthcoming Events

BRITISH PHARMACEUTICAL CONFERENCE, July 16–20. To be held at Leeds.

SOCIETY OF CHEMICAL INDUSTRY, July 16–20. Annual Meeting to be held at Cardiff.

July 17, Dr. J. T. Dunn: "Science and Industry—the Fertility of Ideas" (Presidential Address).

July 19, Prof. H. Freundlich: "Plasticity the Servant of Industry". Sir Harry McGowan: "The Uneven Front of Research".

July 20, Col. C. H. Bressey: "British Roads Development during the past Fifteen Years".

BRITISH MEDICAL ASSOCIATION, July 20–23. Annual General Meeting to be held at Bournemouth.

Official Publications Received

GREAT BRITAIN AND IRELAND

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 1, No. 1: Studies on the Physiology of Reproduction in the Ewe. Part 1: The Symptoms, Periodicity and Duration of Œstrus; Part 2: Changes in the Vagina and Cervix; Part 3: Gross Changes in the Ovaries. By Dr. R. Grant. Pp. 47 + 2 plates. 6*s*. 6*d*. Vol. 58, Part 1, No. 2: Notes on the Kidston Collection of Fossil Plant Slides. No. iii: Some Points in the Anatomy of *Sigillaria elegans* Brongniart; No. iv: On the Nature of the Corona and its Relationship to the Leaf-Traces in the Lepidodendreæ and Sigillariæ, with special reference to certain "Diploxyloid" Specimens in the Kidston Collection. By Dr. Mary G. Calder. Pp. 49–62+1 plate. 2*s*. Vol. 58, Part 1, No. 3: The Spermatogenesis of the Axolotl (*Amblystoma triginum*). By Robert Carrick. Pp. 63–74+3 plates. 3*s*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Royal Society of Edinburgh, Session 1933–1934. Vol. 54, Part 1, No. 7: Spermatogenesis in *Drosophila pseudo-obscura* Frolowa. 2: The Cytological Basis of Sterility in Hybrid Males of Races A and B. By Dr. P. Ch. Koller. Pp. 67–87. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1*s*. 9*d*.

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1933. Part 1, with Report of the Geological Survey Board and Report of the Director. Pp. iii+93. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

OTHER COUNTRIES

Royal Observatory, Hong Kong. Meteorological Results, 1933. Prepared under the direction of C. W. Jeffries. Pp. iv+120. (Hong Kong: Government Printers.) 3 dollars.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 77: Studies on the Phosphorus Requirements of Sheep. 1: The Effect of a Diet deficient in Phosphorus but containing Digestible Proteins and Vitamins. By Sir Charles J. Martin and A. W. Peirce. Pp. 44+2 plates. (Melbourne: Government Printer.)

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1933. Pp. lxii+215. (Bern: Paul Haupt.)

Comparative Psychology Monographs. Vol. 10, No. 1: Modes of Behavioral Adaptation in Chimpanzee to Multiple-Choice Problems. By Robert M. Yerkes. (Serial No. 47.) Pp. 108. (Baltimore, Md.: Johns Hopkins Press.) 1.50 dollars.

Department of Science and Agriculture, Jamaica. Entomological Circular No. 14: Pests of Banana in Jamaica; Lecture delivered on the occasion of the Agricultural Open Week, held at Hope by the Department of Science and Agriculture, in July 1933. By W. H. Edwards. Pp. 20+11 plates. (Jamaica: Government Printing Office.)

Transactions of the San Diego Society of Natural History. Vol. 7, No. 30: Notes on some Types of North American Birds. By A. J. van Rossem. Pp. 347–362+plate 27. Vol. 7, No. 31: Two New Races of the Black Chachalaca from Central America. By A. J. van Rossem. Pp. 363–366. Vol. 7, No. 32: A New Race of Piranga bidentata from Central America. By A. J. van Rossem. Pp. 367–368. Vol. 7, No. 33: A Northwestern Race of the Varied Bunting. By A. J. van Rossem. Pp. 369–370. Vol. 7, No. 34: A Subspecies of the Brown Towhee from South-Central Texas. By A. J. van Rossem. Pp. 371–372. Vol. 7, No. 35: A New Form of Pocket Gopher from Southern Mons County, California. By Laurence M. Huey. Pp. 373–374. Vol. 7, No. 36: The Mammals of Southern Nevada. By William Henry Burt. Pp. 375–428. Vol. 7, No. 37: West American Species of the Genux Liotia. By A. M. Strong. Pp. 429–452+plates 28–31. Vol. 7, No. 38: Some Corrections needed in Recent Carcinological Literature. By Steve A. Glassell. Pp. 453–454. Vol. 7, No. 39: A Review of the Races of Geococcyx velox. By Robert T. Moore. Pp. 455–470. (San Diego, Calif.).

Boston Society for Psychic Research. Bulletin 22: The "Walter"–"Kerwin" Thumb Prints. Pp. 85+8 plates. (Boston, Mass.)

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. 85. Pp. iii+438+17 plates. (Philadelphia.) 6.25 dollars.

State of Connecticut. Public Document No. 24: Fifty-sixth Report of the Connecticut Agricultural Experiment Station, New Haven, for the Year 1932. Pp. xii+832+57. (New Haven, Conn.)

Kungl. Sjokarteverket. Jordmagnetiska Publikationer Nr. 9: A Magnetic Survey of Sweden made by the Hydrographic Service in the Years 1928–1930. By Gustav S. Ljungdahl. Pp. 37+6 plates. (Stockholm.)

Smithsonian Miscellaneous Collections. Vol. 90: World Weather Records, 1921–1930. Collected from Official Sources by Dr. G. C. Simpson, Robert G. Mossman, Sir Gilbert Walker, Frances L. Clayton. Assembled and arranged for publication by H. Helm Clayton. (Publication 3218.) Pp. viii+616. (Washington, D.C.: Smithsonian Institution.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 23. (New York City.)

CATALOGUES

Alloy Steels: an Historical Survey. By Prof. Sir Harold Carpenter. (Nickel, A21.) Pp. 8. (London: The Mond Nickel Co., Ltd.)

A List of Books on all branches of Natural History. Pp. 20. (Sunninghill: Sunninghill Book Co.)

Absorptiometer for Liquids designed by Moll, Burger and Reichert. (Aso 34.) Pp. 4. Standard Thermopile of Moll and Burger. (Bolo 34.) Pp. 4. Non-Recording Microphotometer. (Nomi 34.) Pp. 2. (Delft: P. J. Kipp en Zonen.)

The Wild-Barfield Heat-Treatment Journal. Vol. 1, No. 1, June. Pp. iv+14. (London: Wild-Barfield Electric Furnaces, Ltd.)

The National Park of the Gran Paradiso. Pp. 20. The National Park of Abruzzo. Pp. 20. (London: Italian State Tourist Department.)

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Archæological Exploration in the East

"What songs the *Sirens* sang or what name *Achilles* assumed when he hid himself among women, though puzzling questions are not beyond all conjecture. What time the persons of these Ossuaries entred the famous Nations of the dead, and slept with Princes and Councillors, might admit a wide solution. But who were the proprietaries of these bones, or what bodies these ashes made up, were a question above Antiquarism."

So wrote Sir Thomas Browne nearly three hundred years ago. To-day, while the Sirens' song is still a subject for argument—witness recent discussion on the character of ancient music—it would be possible to tell Sir Thomas Browne nearly as much of the urns which moved him to eloquent meditation and their makers as he could have learned about the pots which, doubtless, came to pieces in the hands of his kitchen maids. In the interval between the seventeenth century and the twentieth, study of the remote past—remote, that is, in the human sense—has travelled a long road. The story of the urn is no longer food for the philosophic speculation of the scholar, its form and decoration a theme for the æsthetic appreciation of the dilletante. Their tale is told in the inferences of the prehistorian, whose conclusions, if subject to the constant revision inevitable in a field of growing knowledge and ever more informed interpretation, is set upon a basis of assured knowledge, a body of fact collected, collated and recorded with the nearest possible approach to a high standard of scientific accuracy.

The life of man has many facets; and the study of man can neglect any one of them only at the price of a distorted picture. Full understanding of the life of ancient Greece and Rome did not begin until their literature was interpreted in the light of the monuments, and still more of the common objects of everyday use revealed by the spade in the streets, shops, dwelling-places and cemeteries of the buried cities of classical sites. On the other hand, prehistoric archæology, relying necessarily on the material products of human activities—tools, weapons, utensils, and in the later phases, the dwelling-places of man and god—must often fail, in the absence of written records, to throw light on the causes and on the sources of crucial developments in cultural history, which initiate further advance in the progress of civilisation.

It is only at the dawn of history and in certain centres of civilisation that contemporary written records, not yet all completely decipherable, give

aid to the archæologist in the interpretation of the evidence of his excavations. When he looks to tradition, it is a nice question on which side lies the greater obligation; for while tradition may afford a clue to interpret a break in the sequence of cultural material or the evidence of a conflagration, tradition may more often find corroboration in the explorations of the archæologist. Thus we may conclude, for example, from the story of the final catastrophe at Jericho, of the dynasties of Ur, and most convincingly of all from the cultural and dynastic background which is now known to lie behind the traditional power of Minos of Crete.

The importance of the Near East in the history of cultural development is passing into a commonplace. There is no other area in the whole world in which the story of the rise of man from primitive beginnings to the complexities of life in a highly organised city community can be traced with the continuity and the completeness of understanding that is possible here. However much future exploration may bring modification of detail, the picture which is emerging with rapidly increasing clearness, as the result of recent archæological exploration, is one in which can be seen the main outlines of the Ancient East as one vast archæological province, extending from the Mediterranean to India, in which locally developed civilisations came into intimate contact, influenced and sometimes absorbed or even overwhelmed one another.

Great movements, such as the rise of the Kingdom of Hammurabi, the incursion of the Kassites into Mesopotamia and the Aryans into India, the ebb and flow of the Hittite and Egyptian Empires on the borders of Syria and Palestine, are in some ways less impressive, perhaps because of a type more familiar, than the evidences of Sumerian influence in prehistoric India, the penetration of Mesopotamian commerce and commercial methods to Hittite lands in the third millennium B.C. and the mixture of peoples and cultures which emerges from the material recently unearthed in Syria at Ras Shamra. Much as we may be impressed by the mass of historic detail, which has been recovered and pieced together with a coherence which would have seemed unattainable little more than a generation ago, it is always the unbroken range of evidence for the rise of man from a stone-using savage to citizenship of a world-wide empire—as the world then was—with all that it implies of material and moral advancement, to which we here return time and again with renewed interest.

Archæological exploration in the past has been much of an adventure in a strange country, in which no one has known what the turn of the next corner might not bring forth. Our knowledge of early civilisations of Bible lands was in the first place a by-product of the search for evidence to support scriptural texts; and although Ur had been the site of previous excavation, no one had anticipated a find such as that of the Tombs of the Kings with their wealth of artistic material and the light they have thrown on the cult of the royal dead in ancient Sumeria. Now, however, the day of isolated and unco-ordinated exploration is passing, if it has not already gone. The number of expeditions which take the field at the beginning of each season is greater than ever before; and each has a clear conception of what it expects, or hopes, to find. The correlation of results, from time to time, not only gives a picture covering a wider area than formerly; it has also revealed the strategic points in time and space at which evidence is most needed at any given moment—and where it is most likely to be found. It was this, to take a single instance, which gave special significance to the results obtained by Mr. E. L. Mallowan at Arpachiyah. Following immediately on the excavations at Nineveh, they supplied welcome data to bring northern Iraq into line with the evidence from early sites in India, to the south and in the Ægean.

Archæological exploration on a basis of reasoned direction has peculiar advantages in the East, where geographical conditions can be readily interpreted in terms of influence on human activities; but it is difficult of full attainment where a number of expeditions under independent control are at work. The advantages of organised research on a number of sites under unified direction are well exemplified in a report, which has been prepared by Prof. J. H. Breasted, for a survey of the activities of the University of Chicago now in progress. This report* deals with the work of the Oriental Institute of the University, an institution of which Prof. Breasted himself was the founder and is the inspiration. He here describes both the field-work and the research which is being carried on within the four walls of the Institute, or by scholars from outside who are associated with its organisation. Archæologists will appreciate the

* The Oriental Institute. By James Henry Breasted. (University of Chicago Survey, Vol. 12.) Pp. xxiii+455+2 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1933.) 13s. 6d. net.

generalship of the field work, while envying the financial resources which have made it effective. The campaign has been planned to occupy such a series of strategic points in Egypt and western Asia as will give the maximum effect, not only in elucidating decisive epochs of the historical succession of events, but also crucial phases in the development of culture and the rise of man.

At the time of the preparation of Prof. Breasted's report, the Oriental Institute had been responsible for thirteen 'undertakings' in the field, of which twelve are still in operation. Of these, six are in Egypt and north-east Africa, and six in western Asia. The distribution of the Asiatic sites is especially to be noted. Four lie along the lands flanking the desert which Prof. Breasted has happily termed "the Fertile Crescent"—at Megiddo, Calneh, Khorsabad and Tell Asmar—and two are in the mountain zone which backs the "Crescent", one at the western extremity—Arpachiyah in Anatolia, and the other at Persepolis at its eastern end.

We cannot follow in all its detail the focusing of research which is implied in the choice of these sites; but one or two salient features call for reference. Megiddo, the gate of entry to Palestine from the north, and the battle ground of the nations, has revealed for the first time the general plan of a considerable Palestinian city; a Canaanitish city also is being unearthed, beneath which, it is anticipated, may lie evidence of early prehistoric man. This site has provided material for a corpus of Palestinian pottery with characteristic 'fossils'. At Calneh, west of Aleppo in Syria, streams of influences from the Mediterranean and western Asia come together; with them is evidence of the incursions of the Hittites into "the Fertile Crescent" to seize Egyptian conquests in this north-eastern corner of the Mediterranean. At Khorsabad and Tell Asmar, north-east of Babylon, the Sargonid period—though not exclusively—has been the centre of interest, and under Dr. H. Frankfort's exploration, the latter site has yielded new material for an understanding of Sargonid culture and for dating purposes in the third millennium B.C. as the first fruits of a campaign planned to last ten years. In the Highland zone, an area of characteristic culture and ethnologically important as a source of Armenoid broad-heads, the origins of the Hittite empire and culture are being probed at Alishar.

What, however, may prove the greatest undertaking of all has been initiated at Persepolis, where an almost unknown sequence of cultures extends from the neolithic age to the time of Cyrus and beyond. The work of the expedition varies from the examination of a prehistoric village which has yielded a previously unrecognised type of painted pottery, earlier than any previously known, including Susa I, to the restoration of the Achæmenid palace, the greatest monument of early Persian art.

In Egypt the undertakings of the Institute are no less crucial. The problems of man's earliest phases of cultural development are being explored in a geological and archæological survey, of which the first stage has been initiated by Dr. K. S. Sandford in the Nile Valley. It will be transferred at a later date to the Euphrates–Tigris area. For each later phase of special significance in Egypt, there is an appropriate centre of activity: the beginnings of economic, social and moral development in the Old Kingdom tombs of Saqqarah; the examination and record of the 'Coffin texts', initiated by Prof. Alan Gardiner, for the growth of ideas relating to the life after death in the Feudal Age under the Middle Kingdom, when the national idea was coming into full flower; the architectural and epigraphic surveys of the great temples of the Empire at Medinet Habu; and the study of Egyptian pictorial art as exemplified in the wall paintings of Abydos (again a work initiated by Prof. Alan Gardiner), where the Institute has worked in conjunction with the Egypt Exploration Society.

The Institute's field activities extend from the palæolithic age down to Byzantine and Moslem times, a remarkable range to be covered by a single organisation. Yet nothing has been said of the great tasks necessary to be carried out at home to keep abreast with progress in the field. What is at present the greatest undertaking in this department, the Assyrian dictionary, must be served with a passing reference. Its compilation began in 1921; it will include 20,000 figures, and five years more must elapse before even the filing is completed.

If archæological studies owe a debt of gratitude to John D. Rockefeller, Jr. for the financial support of several of the Institute's 'undertakings' which made them possible, no less credit is due to Prof. Breasted for the enthusiasm which inspired that generosity and the devoted efficiency which has justified it.

Physiological Studies of Fungi

Researches on Fungi. By Prof. A. H. Reginald Buller. Vol. 5: *Hyphal Fusions and Protoplasmic Streaming in the Higher Fungi, together with an Account of the Production and Liberation of Spores in Sporobolomyces, Tilletia and Sphærobolus.* Pp. xiii+416. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 25*s.* net.

PROF. BULLER in the latest volume of his "Researches on Fungi" has broken away somewhat from the main theme of his previous four volumes in that he is not here concerned mainly with the structure of the hymenium and the production and liberation of basidiospores. The method of treatment is the same, however, and there is the usual detailed description of the way in which the results were obtained, abundance of illustrations and full summary. As the secondary title indicates, the volume is divided into two parts.

The first chapter deals with the formation of hyphal fusions in the mycelia of the higher fungi. Every mycologist is aware of the frequency of such fusions, and the first twenty-five pages refer to previous published work, including a useful summary of Burgeff's important researches on the parasitic Mucorineæ. As the result of his own investigations, the author holds that all hyphal fusions are essentially end to end, and he analyses the different ways in which they are brought about. The mode of formation of the important clamp connexions, present in most diploid mycelia, is fully considered. The view that these have some sexual significance is rejected—"the clamp-connexion may be regarded as a means for providing between any two adjacent cells of a diploid mycelium two septa instead of one and, therefore, two passage-ways for the streaming of the protoplasm instead of one".

The second chapter is concerned with the translocation of protoplasm. The streaming of protoplasm must have been noted by everyone who has examined a living mycelium under a microscope, and there have been several detailed studies of the phenomenon. Most of these, however, have been on members of the Phycomycetes, where there is a continuous mycelium, and little attention has been paid to how streaming could occur in septate mycelia. The presence of pores in the septa has been recorded in many fungi, and, indeed, Wahrlich in 1893 found protoplasmic connexions in every fungus he examined except *Oidium lactis*. It is surprising how this important point has been neglected except to bolster up the once popular 'Floridean ancestry' idea. Summarising previous observations, Buller says: "we may conclude that Ascomycetes, Basidiomycetes, and Fungi Imperfecti resemble Phanerogamia, Pteridophyta, Muscineæ, and multicellular Algæ in that all the living cells which make up an individual plant are connected together so as to form a single mass of protoplasm". In his own observations he found that vacuoles will pass through the pores in the septa and that the rate of flow of the protoplasm is about the same in the thin septate hyphæ of certain Ascomycetes as in the non-septate and relatively thick hyphæ of Phycomycetes; apparently the septa offer but little resistance to the flow of protoplasm from cell to cell. The general flow is in one direction only, from older hyphæ which have ceased to grow towards rapidly growing younger hyphæ.

Woronin in 1886 recorded that in *Ascobolus pulcherrimus* a few highly refractive particles could usually be seen on one or both sides of each septum, and these were more fully studied by Ternetz (1900) in *Ascophanus carneus*. They have since been recorded by several observers, sometimes being called 'metachromatic bodies'. Buller regards this designation as unsatisfactory and proposes the name 'Woronin bodies'. This seems equally unsatisfactory, as it is liable to be confused with the well-known 'Woronin's hypha', a term introduced by Füisting more than sixty years ago for a certain type of archicarp.

When a cell on one side of a septum is killed, the pore is immediately closed by a plug of coagulated protoplasm so that the escape of protoplasm is prevented. At the same time the septum is bulged outwards from the living cell by osmotic pressure.

The biological significance of septation, perforation and imperforation (Phycomycetes), and protoplasmic streaming are fully discussed.

Although it is probable that the main facts of the first part of the present volume were more or less generally known, it is certain that their significance in relation to recent advances in our knowledge of the life-histories of the higher fungi was little realised.

Part two of the volume is concerned with *Sporobolomyces*, *Tilletia Triticii* and the *Sphærobolus* gun and its range.

Sporobolomyces was founded by Kluyver and van Niel in 1924 for certain reddish yeasts which

discharge spores into the air "by means of a peculiar mechanism". First observed by Lasché in 1792, they had been known since 1894 to produce a mirror-picture formation on the lid of an inverted Petri-dish culture. Kluyver and van Niel showed that the yeast cell forms a spore on a pedicel and that discharge is brought about by a drop excretion mechanism similar to that found in Hymenomycetes and rusts. They regarded *Sporobolomyces* as a Basidiomycete. As was to be expected, this idea has given rise to some controversy. In 1930, Derx proposed the family Sporobolomycetes to include *Sporobolomyces* and a second genus differing in colour and shape of spores which he appropriately named *Bullera*. A detailed account of *S. roseus* is given by Buller. He confirms Kluyver and van Niel's general account but states that two, three or possibly four spores are often produced in succession from the same sterigma. Guilliermond's statement that the cells are uninucleate at all stages and do not show karyogamy is also confirmed.

The Sporobolomycetes are of great systematic interest. Are they Basidiomycetes ? Buller holds that "(*a*) the peculiar shape of the conidium which is due to its possessing an excretory hilum that is developed on one side of the top of the sterigma, (*b*) the presence of a sterigma of typical conical shape beneath each conidium, and (*c*) the discharge of the conidium by the drop excretion-mechanism . . . clearly indicates that *Sporobolomyces* belongs to the Basidiomycetes".

It is not possible to enter into the many points that have to be considered in coming to a conclusion. The yeast cell is certainly not a basidium, and the repeated production of spores from the sterigma is anomalous for a Basidiomycete. Buller's point of view is perhaps best expressed in a footnote on secondary spores. "If one assumes, as Lohwag evidently does, that only a basidium can produce a basidiospore, then, of course, it is impossible to regard a secondary spore as a basidiospore without confusion in ideas and terminology ; but, if one does not make that assumption, then one has no difficulty in regarding a secondary spore, which exactly resembles in outer form, nuclear content, and mode of discharge the basidiospore from which it has been formed, as exactly what it looks like, namely, a basidiospore." It must be remembered, however, that the basidium of a Gasteromycete such as *Sphærobolus* has no sterigmata and consequently no drop-excretion mechanism !

In my opinion the systematic position of *Sporobolomyces* and *Bullera* is still doubtful. It is possible that we may not yet have the whole story of the life-cycle, but whether or no, all suggestions about the possible origin of the group are at present pure guess work.

The main points of the chapter on *Tilletia Tritici* were given in a letter to NATURE of December 26, 1925, pp. 934–5. Here the secretion-drop method of discharge leads to an interpretation of the secondary conidium of Brefeld as a special type of primary sterigma borne by the basidium-body (promycelium). This interpretation will doubtless be questioned by those regarding the promycelium as a basidium. It seems, however, that here we are safer in applying the criterion of spore formation and discharge than in *Sporobolomyces*. Most mycologists regard the Ustilaginales as Basidiomycetes, and the question at issue is merely what are to be regarded as basidiospores. Are the primary conidia the basidiospores, and the secondary conidia what are elsewhere called secondary spores, or are the primary conidia to be interpreted as primary sterigmata as Buller holds, or have we an entirely new interpolated structure ? If we have a new structure, why give it an old name ?

The volume ends with a description of the *Sphærobolus* 'gun'. The glebal mass of *S. stellatus* is a solid spherical body with a diameter of 1–1·25 mm. The minimum range to which this was shot in Buller's experiments was 7 ft. 8·5 in. vertically and about 15 ft. horizontally when inclined at an angle of 45°—a remarkable range when the size of fruit-body and glebal mass are considered. The kinetics of the propulsion are fully worked out.

Prof. Buller's method of presenting his results is not one that appeals to everyone, but it is certain that the facts recorded in the volume under review will have considerable influence on mycological ideas. J. RAMSBOTTOM.

The Way and the Truth

The Universe of our Experience. By Dr. L. M. Parsons. Pp. 186. (London : Williams and Norgate, Ltd., 1933.) 7*s.* 6*d.* net.

A New Fundamentalism. By James Maxwell Henry. Pp. 226. (London : Macmillan and Co., Ltd., 1934.) 7*s.* 6*d.* net.

THESE two books are symptomatic of the universally felt need of a new outlook in philosophy which will enable the recent startling

changes in science to be regarded as natural developments instead of a lapse into insanity. Neither would profess to meet the need fully, but the authors of both address themselves to a larger task than the mere description of the present position. Each author makes an attempt at a summing-up, Dr. Parsons's conclusion being that a single comprehensive philosophy is scarcely possible, while Mr. Henry offers us a unifying hypothesis which, whether possible or not, is scarcely credible.

(1) Dr. Parsons's book is intended to present to the plain man "a connected series of universe pictures . . . sketched from different positions", its justification being that "no one branch of knowledge can lead us to a sound conception of the universe or provide us with that encouraging outlook so essential to human progress". The book may be thoroughly recommended to those who, like the author, seek encouragement. It is well written, bears evidence of a wide expanse of reading, and contains many suggestive ideas which the reader capable of thinking for himself may develop with profit. Physics, biology, psychology, philosophy and the "higher realm of personality" provide in turn the points of view from which the sketches are made; and prominence is given to the most recently discovered elements in the various scenes.

It is impossible not to recognise and admire the author's sincerity, but it is necessary to say that those who seek Truth though the heavens fall will not find here the impartiality they require. The book is essentially propagandist, and though it cannot be said that this is disguised, we feel that it might with advantage have been made to appear as clearly in the earlier as in the later pages; that, for example, the proposed search for a conception of the universe which will be "satisfactory" (an "unsatisfactory" word which occurs far too often in the first few pages) might have been more definitely described as one which will satisfy our desire for comfort and not necessarily for truth. However strongly one may agree with the author's ultimate aim, it is hard to avoid the feeling that the best methods have not been adopted. In matters on which men of science of the highest repute are honestly at variance, it is distinctly unpleasant to find one set of ideas described as entirely reasonable and the other as "unwarrantable" or "a crowning impertinence". The assumption underlying the book is best expressed on the last page, where it is stated that a man "can accept materialistic realism with its depressing implications and then assume an attitude of contemptuous defiance towards an apparently hostile universe; or he can accept some form of idealism which recognises mind and spirit as fundamental; in which case he will regard himself as a humble but vital unit performing an allotted function in the development of a holistic universe psychically activated. Being the captain of his soul he can make his choice". This reads strangely to those who feel that the choice is made for them by the entirely involuntary response of their reason to the available evidence, and we doubt whether Dr. Parsons's converts will belong to what he would regard as the highest type. He is capable of better work than this.

(2) Mr. Henry starts from a diametrically opposite position. To him "Truth is higher than goodness or beauty". "The deadly materialistic fog of Victorian science," says Dr. Parsons, "enveloped the world of thought . . . But now, with the great advances of scientific knowledge, the fog has lifted . . . The light of spiritual life is brightening once again." In Mr. Henry's view, however, "it is just as hard for us to rid our minds of the scientific fog of the present century as it was for the Victorians to rid their minds of the religious fog of the nineteenth". (It is interesting to note in passing how easily facts can be distorted by perfectly honest persons. In the Victorian age taken as a whole, was science felt to be an incubus on religious aspiration, or was religion regarded as a drag on the progress of science? This is a question of fact, not of opinion, and if both states of mind existed in comparable intensity, it is unjust to characterise the age, as both our authors do, by one of them alone. There is always the possibility, too, that the Victorians were not so fogbound after all.)

Mr. Henry agrees with Dr. Parsons in electing to survey broadly the whole field of thought and feeling instead of examining minutely a restricted part, but he gives us a very different picture. To him, everything points to the earthly existence in the past of a Golden Age when beings lived who knew neither sin nor death, whose minds were a hundred per cent conscious, and whose intelligence directed their own evolution. An unexplained 'Fall' occurred and then evolution ceased, but the author believes (like Shelley, though on very different grounds) that somehow "more than the former glory will be restored". Readers of NATURE will probably agree in holding that

intellectual conclusions are of value only when the data leading to them have been carefully examined and authenticated. Mr. Henry, however, has made it his aim "to regard every fancy which human beings have entertained as entitled to serious consideration"; and by this he does not mean consideration by psychologists as throwing light on the nature of mind, but consideration as evidence of objective fact, so that, for example, the existence of legends in which animals talk is evidence that in the Golden Age they, like men, spoke rationally.

Feeling ourselves absolved, therefore, from treating its conclusions seriously, we may with an easy conscience recommend the book warmly as a stimulant to thought on account of the many suggestive ideas which it adumbrates. It is written in an epigrammatic, semi-Emersonian style, rising at times to brilliance, which is excellent for sowing the seeds of thought but ill-fitted to display the fruits. Mr. Henry is like a man who discerns many attractive avenues into the unknown, but instead of treading any of them, guesses where they will lead. We have no use for his guesses, but we thank him for showing the ways. HERBERT DINGLE.

Science and Society

Scientific Research and Social Needs. By Julian Huxley. With an Introductory Chapter by Sir William Bragg, and Discussions with Prof. H. Levy, Sir Thomas D. Barlow and Prof. P. M. S. Blackett. (The Library of Science and Culture.) Pp. xvi+287+40 plates. (London: Watts and Co., 1934.) 7*s*. 6*d*. net.

IN this book, Prof. Julian Huxley has given a connected picture of 'British science', with particular reference to its relation to social needs, as the outcome of a broad survey of the whole field, undertaken by him at the suggestion of the British Broadcasting Corporation. The basis of the book is furnished by twelve talks and discussions that were broadcast. Here they have been considerably revised and amplified to fit them for publication in book form. The result is a volume of outstanding interest, fascination and usefulness.

In his preface the author says: "I became more than ever impressed with the fact that both our existing structure of civilization and our hope of progress are based on science, and that the lack of appreciation and understanding of science among business men, financiers, educational authorities, politicians, and administrators was a serious feature in our present situation." He adds: "Almost equally serious, however, is the absence of a broad scientific outlook on life, too often to be noted in the scientific specialist as well as in the layman." The most important lesson he learned from his tour was the realisation of the little extent to which the psychological and social sciences find any public support and practical application, as compared with the physico-chemical side of science and, to a less degree, with the biological sciences. His main plea is the need not only for scientific research in the narrow specialist sense, but also for the scientific spirit and method in careful planning.

Sir William Bragg, in an interesting introductory chapter, prepares the way for Prof. Huxley, by taking the reader with him on an imaginary journey round the little corridor outside the lecture theatre of the Royal Institution, where there are exhibited the pieces of apparatus which have been used by great experimenters of the last hundred years, particularly by those who have worked in the Institution. Taking these exhibits as his texts, Sir William Bragg reviews rapidly some of the salient features of the work of Count Rumford, of Sir Humphry Davy, of Faraday, of Tyndall, of Lord Rayleigh, and of Dewar, and sketches briefly, with the lucid simplicity characteristic of his writing, the far-reaching industrial and social developments that have sprung from the work of these pioneers; and the stage is set for Prof. Huxley.

In the twelve chapters that follow, the author ranges over a vast field, making a broad survey of the work and influence of science in regard to such matters as food, building, clothing, health, communications, industry, war and international needs. There is a chapter on "Man and Society" and one on "Pure Science", and the final chapter consists of a "Summing Up", in which the author discusses with Prof. H. Levy the main lessons to be learnt from what is rightly claimed, in a foreword, to be "one of the first surveys of science in relation to many aspects of social needs".

Let it be said at once that the book is as fascinating to read as an exciting novel. Thanks to the author's lucid exposition and smooth literary style, it can be read with effortless comprehension by the layman, even with his feet on the mantelpiece. It may be that the broadcast form in which the substance of the book was first delivered has helped to give it, as a whole, the conversational

ease of an intelligent and earnest talk over a pipe. But the concrete facts—crowds of them—and the close argument are there all the same and all the time. The present reviewer prefers those chapters in which Prof. Huxley alone speaks. The discussions with Prof. Levy, Sir Thomas Barlow and Prof. P. M. S. Blackett (especially that with Prof. Blackett) have much interest, but it is doubtful whether there is anything gained, either in clearness or in liveliness, by this resort to the Socratic method of exposition. It may tickle the ears of the wireless listener to hear the great and eminent call each other by their surnames, but, when it comes to reading a book, the flow of the argument is apt to be a little inconsequent in this highly intellectual 'backchat' (if one dare use such a phrase in such a connexion).

It is impossible within the limits of a short review to give an adequate idea of the wealth of illustration employed by Prof. Huxley to show what science has done and is doing in diverse fields. The facts lose nothing in their telling, and the scientific specialist, as well as the layman, will learn much that will be news to him. The book is, however, much more than an able marshalling of facts inherently interesting as to the part being played by science in our social and industrial life. It has all the qualities of an intellectual tonic in that it stimulates thought beyond its own range and at times almost makes one jump out of one's chair to do something. As the author shows, the work that science has done, great as it is, is but little in comparison with what it could do and might do if it were given full scope. To take one example of his suggestiveness, here is a passage from the chapter on "Man and Society": "We have got a great deal of control—quite enough to get on with for the time being—over lifeless nature: we have practically no control over human nature, and over the monsters we have unconsciously created, or at least allowed to grow up unchecked, in the shape of economic systems, unintelligent moralities, nationalist sovereign states, mass ignorance and mass hysteria."

It is to be hoped this book will be widely read, for every one of its readers will be helped to get a better perspective of what science has done, is doing and may yet do for life as a whole, in all its varied manifestations. As the author says in concluding his chapter on "Science and International Needs": ". . . science *is* influencing the world structure. Its applications are making frontiers look ridiculous, and war ever more and more appalling. Its findings and its inevitably international outlook are gradually penetrating general consciousness and showing up the stupidities of nationalist restrictions and rivalries. Science, as much as any other force, is making for the breakdown of the system which has given it birth, and in whose bounds it is now confined and cramped. Though for the time being it may be exploited for sectional ends, and may actually intensify present rivalries, in the long run it is hard to see how each new advance in science can help preparing the way, however deviously, and through however much of preliminary chaos, for the world-state".

Finally a tribute should be paid to the persuasive and reasonable tone in which the whole book is written. It does not reject Matthew Arnold's plea for "sweetness and light".

J. W. W.

Short Reviews

Theorie der Elektrizität. Von Prof. R. Becker. Neubearbeitung des Werkes von M. Abraham. Band 1: *Einführung in die Maxwellsche Theorie der Elektrizität, mit einem Einleitenden Abschnitte über das Rechnen mit Vektorgrössen in der Physik.* Neunte Auflage. Pp. vii+261. 14.50 gold marks. Band 2: *Elektronentheorie.* Sechste vollständig neubearbeitete Auflage des Werkes von M. Abraham. Pp. vii+400. 17 gold marks. (Leipzig und Berlin: B. G. Teubner, 1932–1933.)

THESE two volumes represent together a new edition of the now familiar "Theorie der Elektrizität" of Abraham. The first volume maintains more or less the old form and contains a generally well-balanced account of classical electric theory in its broader aspects, emphasis being laid on the mathematical formulation of the leading physical principles rather than on their detailed application in special cases. It is, however, disappointing to find the author still persisting with the usual confused treatment of magnetic energy and also with an elaboration of Helmholtz's treatment of dielectric stresses, which was shown by Larmor some forty years ago to be both mathematically inconsistent and physically impossible.

The second volume has been entirely re-modelled from the original form due to Abraham. A number of sections of the original discussion which have proved to be non-essential have been omitted and the opportunity taken to discuss the more recent developments of electron theory—bringing it to

the borders of quantum theory—and also the more generalised aspects of relativity. In these new developments there is no attempt at exhaustiveness, the object being merely to show as clearly as possible the relation between the older ideas and results of the electron theory and the form which these ideas take in the more modern aspects of the subject.

Generally, one can but compliment Prof. Becker on having retained the spirit of the older work in a book, written more in conformity with modern needs, and which can therefore be commended to all students commencing a study of these fascinating subjects.

Romping through Physics. By Otto Willi Gail. Translated from the German by H. Stafford Hatfield. Pp. 64. (London: George Routledge and Sons, Ltd., 1933.) 4*s.* 6*d.* net.

THIS little work is not, as one might suppose from its title, an ultra-humanised physics textbook, but is an altogether remarkable and diverting account, written in colloquial style, of the laws of Nature as applied to ordinary and extraordinary sets of circumstances and apparent anomalies. There are no chapters; after a few pages on heat the book goes on to mechanics: weight, centrifugal force, lifts, gravity. One discovers why a sunken ship must always reach the bottom of the sea irrespective of the depth, and that wood must float in air at the bottom of a mine 30 miles deep. Finally, the problem of a man falling down a shaft bored through the centre of the earth is elucidated, and the amazing consequences of a sixteen-fold speeding up of the rotation of the earth on its axis are described. The pages are enriched with no less than 103 semi-humorous drawings in colour, and these, together with the general style of the production, make the book something of an artistic achievement.

By judicious use of some of the ideas an enterprising teacher of mechanics might contrive to enliven and stimulate considerably a subject which more often than not is rendered dull and uninteresting.

North Sea Monster. By D. A. Spencer and W. Randerson. Pp. 246. (London: Houghton and Scott-Snell, 1934.) 7*s.* 6*d.* net.

THE dust-cover of this story of adventure, in which "every incident . . . is scientifically possible" (although usually statistically improbable), suggests that when two men of science, one of whom is a humorist and the other a student of international affairs and a world-wide traveller, collaborate to write a novel, it is to be expected that the result will be unusual. That many authors of 'thrillers' lack humour, appreciation of international affairs, and the most elementary knowledge of science is doubtless true and regrettable; that it is possible to avoid the usual defects of such a novel and produce a readable and, in fact, properly exciting, story at the same time has now been demonstrated. The authors do not pretend to make any contribution to serious scientific literature; they are frankly disposed to entertain, and possibly to show that scientific people laugh and shiver with the rest. Nevertheless, they make use of their opportunities to comment on the folly of war and on the absurdities of a situation in which those who seek peace and ensue it need to be heavily armed for their quest. Where argument and example fail, ridicule—competently enveloped in a garb of fiction—may play a useful part.

The General Principles of Quantum Theory. By Prof. G. Temple. (Methuen's Monographs on Physical Subjects.) Pp. viii+120. (London: Methuen and Co., Ltd., 1934.) 3*s.* net.

THIS monograph gives an introductory account of the general principles which form the physical basis of the quantum theory. The author states that the theory is considered as a branch of physics and not as a branch of mathematics and that the exposition is restricted to a discussion of general principles and does not attempt their detailed application to the wide domain of atomic physics.

The book is, however, wholly mathematical, and could be of service only to a reader having much more than an elementary mathematical equipment. The five chapters deal with the theory of linear operators, the laws of measurement in atomic physics, the exchange relations and the equations of motion, the spin operators, and composite systems. The framework of the modern quantum theory is thus set up in the most concise possible form, as concerning operators and matrices. Wave mechanics, being treated in a separate volume of the series, is excluded except for consideration as that form of the general method appropriate to variables with continuous spectra. N. M. B.

Free Radicals: a General Discussion held by the Faraday Society, September 1933. Pp. iv+248+7 plates. (London: Faraday Society, 1934.) 12*s.* 6*d.*

THE general discussion on free radicals organised by the Faraday Society at Cambridge in September last has now been published in book form (see also NATURE, 132, 665, Oct. 28, 1933). The subject was discussed under the general headings of free radicals of relatively long life and of short life from both the physical and chemical aspects. A number of distinguished foreigners were present so that the discussion was fully representative of present knowledge of the subject: it is published with commendable promptness. An increasing amount of attention is being given to the ionic theory of organic reactions; the discovery of free radicals of the triphenyl methyl type in 1900 which can be prepared by ordinary chemical means gave the first impetus to the new conceptions; to-day Paneth has isolated methyl and ethyl radicles with a life of only about 0·006 sec. which yet makes it possible to use them in synthetic work; free radicles of short life are often postulated as intermediate products of chemical change.

William Hyde Wollaston, F.R.S. (1766-1828)

Unveiling of Memorial Plaque

THE great variety of interest and versatility of achievement of the scientific men of the early nineteenth century has often been a matter of comment. The name of William Hyde Wollaston stands among the highest of these workers, and that time has not detracted from his reputation is attested by the honour done to his memory in the past few days. As a result of the co-operation of no fewer than six societies—the Royal Society, Geological Society, Royal Astronomical Society, Chemical Society, Physical Society and Mineralogical Society—a memorial plaque was erected on 14 Buckingham Street, W.1, a house occupied by Wollaston from 1801 until 1825 ; and was unveiled on July 4 by Sir Frederick Gowland Hopkins, president of the Royal Society. The scheme was initiated by the Geological Society, and, at the ceremony, the Royal Society, Royal Astronomical Society, Chemical Society, and the Mineralogical Society, were represented by their respective presidents. Amongst those who attended were several members of the Wollaston family.

In the course of an address delivered before unveiling the plaque, Sir Frederick Gowland Hopkins said : "Only a few names in the history of science stand out so prominently as to be heard in common parlance . . . it is our hope that in placing Wollaston's name on a house in which he dwelt, we may tempt many more of his countrymen to seek acquaintance with the life's work of a truly great Englishman". Wollaston, after passing through Charterhouse and Gonville and Caius, a college of which he became a fellow, commenced medical practice, but he relinquished it in 1801, as he found the professional duties of medicine wholly uncongenial. "We cannot indeed understand his temperament aright," said Sir Frederick, "unless we fully realise how acutely the anxieties involved in medical practice affected him." He quoted a remark of Wollaston to his friend Hasted in this connexion concerning "mental flagellation termed anxiety". "The anxiety was for his patients who looked to his skill for aid. When he felt that skill to be unequal to their needs he suffered greatly in spirit." Wollaston retained his interest in medicine, however, and the Royal College of Physicians in recognition of his services made him an elect.

"Before he gave up medical practice," continued Sir Frederick, "Wollaston had already published work of general importance, but when first freed from its anxieties he determined to devote himself more particularly to chemical studies." Such, however, was the catholicity of his interests that his publications came to deal, not with chemistry alone, but with a multitude of subjects. "Of some sixty papers mostly published in the *Philosophical Transactions of the Royal Society*, there is scarcely one that lacks real distinction and importance. Their author was an admirable exponent, and his publications are models of what scientific publications should be."

Among his earlier successes, Wollaston made a great advance on the then existing methods of rendering platinum malleable, and, in the course of his experiments, he discovered palladium and rhodium. A paper in 1808 on super-acid and sub-acid salts did much to encourage belief in the law of multiple proportions, and the acceptance of Dalton's atomic theory. As a pioneer in biochemistry he recognised the need for chemical studies in pathology, and discovered cystine, a substance very prominent in biochemical research to-day.

Wollaston applied his chemical knowledge to mineralogy, analysing many minerals and other geological specimens. For crystallography he invented the reflecting goniometer. In the general field of optics he performed pioneer work in spectroscopy, and his total reflection refractometer was employed for his classical experiments on Iceland spar. He is remembered by the Wollaston prism, and the camera lucida ; and it is interesting to note that Fox Talbot's experiments that led to the production of photographic impressions on paper "were the outcome of an idea which came to him when sketching the scenery of Lake Como with the aid of Wollaston's Camera Lucida".

Wollaston also made important contributions to early experimental and theoretical work on electricity, and, from a consideration of contemporary experiments in 1821, "he felt that a conductor carrying an electric current should revolve on its axis under certain applied magnetic conditions. He failed in achieving such a result. But shortly afterwards, Faraday succeeded in obtaining the rotation of a current-carrying conductor around a magnet, and vice versa. A charge of plagiarism was laid by Wollaston's friends. Faraday succeeded in establishing his innocence with Wollaston, who exerted himself later on when Faraday was up for election to the Royal Society to overcome the opposition still existing—his name is the first on Faraday's certificate of candidature".

In the field of astronomy Wollaston's contributions were also noteworthy. "A report of the Council of the Astronomical Society published in 1829 summarising Wollaston's service to the science contained the following statement : 'Among the most remarkable of his astronomical papers, however, is that on the finite extent of the atmosphere, which affords a striking instance of the advantages that may accrue to science by the union of remote branches of knowledge in the same mind.' "

Other examples of this "union of remote branches of knowledge in the same mind" are Wollaston's invention of the cryophorus, his studies of 'fairy rings' in pastures, his work on

sounds inaudible by certain ears, and physiological investigations, such as the duration of muscular motion and sea-sickness, discussed in his Croonian lecture, all of which further attest his wide interests. His skill as a technician was very great and is frequently commented upon by his contemporaries.

Another phase of Wollaston's activities is reflected in his twelve years' secretaryship of the Royal Society, of which he was later interim president, in 1820. He received many honours, an outstanding one being his election as one of the eight foreign associates of the Paris Academy of Sciences. He was a benefactor to the Geological Society and for more than a hundred years that Society has commemorated him by the annual award of the medal which bears his name, the highest which it can bestow.

Wollaston had many close friends among scientific workers at home and abroad and not a few have recorded their deep admiration for him both as an investigator and as a man. "Berzelius for one was an enthusiastic admirer. In some of his letters indeed the great Swede writes of Wollaston in almost extravagant terms of praise. Faraday in 1821 said that 'His character and talents have raised him to be a patron and protector of science. All men look to his opinion and judgment with respect'." "Some of his more intimate friends have left eloquent testimony to his lovable qualities as a man"; "of the great pleasure he always derived from the company of children and young people"; of his modesty "but also upon the indignation he would display when faced with the slightest deviation from honesty and truth, or any departure from justice". Miss Edgeworth sums up an estimate of him in the words "He confirms . . . the opinion I have always held, that great talents are always connected with warm affections—with what is commonly called *heart*".

Sir Frederick Gowland Hopkins acknowledged his indebtedness for information on aspects of Wollaston's scientific work to Mr. L. F. Gilbert, of University College, London, who is engaged in compiling a biography of Wollaston and suggested, in the first instance, the erection of the memorial.

W. T. GORDON.

Yale North India Expedition

By G. E. HUTCHINSON, Osborn Zoological Laboratory, Yale University

ALL the members of the expedition of the Yale North India Expedition 1932–33, under the leadership of Dr. H. de Terra, having returned to Yale University more than a year ago, it is now possible to give a brief preliminary account of some of the results of the field work achieved.

In our geographical studies we were fortunate in securing the services of the distinguished Indian topographer, Khan Sahib Afraz Cul Khan, who surveyed 4,600 square miles of imperfectly mapped country on the western borders of Tibet. Dr. de Terra, using this new map in conjunction with his geological studies, has been able to recognise the eastern continuation of the Karakorum on to the Tibetan plateau[1]. The orographic axis of the range undergoes a bend from north-west–south-east to west–east, so that the Karakorum clearly fails to make its supposed connexion with the Trans-himalaya. The re-entrant, clearly marked in all the component ranges of the Karakorum, is represented throughout the whole of the mountain belt between the Ganges and Central Asia, and corresponds to that of the Gondwanaland mass.

Wadia had previously demonstrated the overthrusting of the southern Himalaya towards Gondwanaland, and this has now been confirmed on a larger scale, embracing the north and central portions of the range. The main geotectonic structure of the entire mountain belt is seen to consist of the southward shifting of successive belts of folding towards India, beginning in the Middle Cretaceous and lasting until to-day. As in the case of the Alps, the overthrusts have moved mainly across 'flysch' and 'molasse' rocks and in many places are connected with basis volcanics in part of submarine origin. In the late Pleistocene, the Pir Panjal Range was added to the Tertiary mountain belt, and various piedmont levels on the Tibetan plateau indicate that uplifts have been of recurrent occurrence throughout the Pleistocene.

Dainelli's idea of four Himalayan glaciations in the Quaternary has in the main been confirmed, but the detailed study of interglacial deposits leads to somewhat different results from those of earlier workers. In relation to the studies carried out on the Pleistocene deposits of the region, our discoveries of human artefacts, though few and fragmentary, acquire a special significance. The most interesting find was a flake of Levallois type discovered in a lake deposit near Srinagar, Kashmir. Another important site, also yielding specimens representing an early palæolithic flake culture, was discovered near Chitta in the Salt Range. A detailed report on this material by Mr. and Mrs. C. Hawkes is now in the press[2].

Mr. G. E. Lewis, palæontologist of the expedition, made a very large collection of Tertiary mammals, principally in the Salt Range and Simla Hill States. Among the rich material of Primates, one form, *Ramapithecus brevirostris*, Lewis, described in a recent preliminary communication[3], deserves special mention. This Upper Siwalik form, represented by a right maxilla and premaxilla, appears in its parabolic dental arcade, small transverse canine alveolus, absence of diastemata, small incisors, high palate and slight prognathism, to approach more closely to the Hominidæ than any previously discovered Tertiary

ape. The presence of such a form in these beds on one hand, and of early palæolithic cultures in the North Indian Pleistocene on the other, inspires the not too remote hope that very primitive hominids may one day be found in this region.

A preliminary note on some of my limnological work has already appeared in NATURE[4]. It is as yet scarcely possible to evaluate the zoogeographical significance of the large collection of fishes and invertebrates brought back. Two points may, however, be briefly noticed.

On the basis of his geomorphological studies, Dr. de Terra has reconstructed[1] the Tertiary drainage pattern of the western part of the Tibetan plateau. A number of rivers ran from west to east, one of them occupying the present valley of the Upper Indus. It is difficult to resist the conclusion that a similar pattern extended farther north, the Tarim basin draining into the Hwang-ho. If this hypothesis be accepted, it is possible to give a rational explanation of the distribution of the most characteristic group of Central Asiatic fishes, the Schizothoracinæ. At present this sub-family occurs in at least twelve major river systems and numerous small closed basins. My field studies appear to indicate that the most primitive genus *Schizothorax* is most abundant in relatively quiet water, while the species found in the most rapid streams belong to the most specialised genera. This is to be expected if we suppose that the sub-family was distributed as the Tertiary drainage pattern suggests, from a centre in the present Karakorum, then a region of comparatively late mature relief, the truly torrenticolous genera such as *Dyptichus* not evolving until the progressive uplifts had provided a system of suitable habitats for such forms. Further problems of distribution are raised by these and other fish, but it would be out of place to discuss them until the entire collection has been studied by Dr. S. L. Hora.

A second zoogeographical result emerges from a study of the insects of high altitudes. In examining the collection of terrestrial Heteroptera, I have been much impressed by the high proportion of endemic forms; at least half the species are peculiar to the higher parts of the Himalaya and western Tibet. This contrasts strikingly with the situation presented by the Pamirs[5], where the fauna though richer is much less peculiar. In spite of the intense Quaternary glaciation of the better-known parts of western Tibet, it seems impossible to avoid the conclusion that a large part of the Tibetan Plateau was unglaciated, forming, as Meinertzhagen[6] has emphasised, a biological island in which species and even genera were differentiated, and from which the glaciated regions were recolonised.

[1] *Geog. Rev.*, **24**, 12; 1934.
[2] *Mem. Connecticut Acad. Art. Sci.*, **8**, 1.
[3] *Amer. J. Sci.*, **27**, 161; 1934.
[4] NATURE, **132**, 136, July 22, 1933.
[5] Kiritschenko, "Abh. der Pamir-Exped. 1920", **8**, 77; 1931.
[6] *Geog. J.*, **70**, 129; 1927.

The Mersey Road Tunnel

THE tunnel constructed under the Mersey for vehicular traffic between Liverpool and Birkenhead, which was opened by H.M. the King on July 18, is a great engineering construction possessing many interesting features. It is the largest sub-aqueous tunnel yet constructed, its ventilation installation is on an elaborate scale and the architectural treatment of its entrances and buildings have received as much consideration as the construction of the tunnel itself. The consulting engineer for the scheme is Sir Basil Mott, Bt., with whom has been associated Mr. J. A. Brodie, for many years the city engineer of Liverpool, while Mr. H. J. Rowse is the architect of the ventilation buildings. Others who have been called in to advise on various matters include Prof. P. G. H. Boswell, Prof. Douglas Hay and Prof. J. S. Haldane.

A railway tunnel beneath the Mersey has been in use since the 'eighties of last century, but the ever-increasing stream of passengers and vehicles crossing the river by the ferries has long shown the need for further facilities. In 1925 the local authorities obtained from Parliament the Mersey Tunnel Act, and under this was set up the statutory body, the Mersey Tunnel Joint Committee, the controlling authority for the construction of the tunnel. The general plan of the project includes a main tunnel for four lines of traffic from Old Haymarket, Liverpool, to Chester Street, Birkenhead, 3,751 yards long, with two branch tunnels for two lines of traffic, one on either side of the river, bringing the total length of roadway up to 5,064 yards. It is estimated that the tunnel will have a capacity of 4,150 cars per hour moving at 20 m.p.h., the time taken for a vehicle to pass along the tunnel being 6½ minutes. Side-walks are provided on both sides of the roadways for the staff, but in normal circumstances the tunnel will not be used by pedestrians.

The portion of the tunnel of greatest interest is that beneath the river bed. Here the bottom of the tunnel is 170 ft. below high water, while above the top is an average thickness of 30–35 ft. of rock, gravel and clay. The rock is red triassic sandstone. Circular in section, this portion of the tunnel has external and internal diameters of 46¼ ft. and 44 ft. respectively. It is thus the largest sub-aqueous tunnel in the world, the Rotherhithe Tunnel, London, having a diameter of 30 ft. and the Holland Vehicular Tunnels, New York, a diameter of 29½ ft.

Begun in 1925, two pilot headings were first driven from each of the two shafts sunk on each side of the river and the workings met almost exactly in the middle of the river bed on April 3, 1928. The divergence of line, length and level was very slight. These pilot headings were then

progressively enlarged, and stage by stage the tunnel was lined with cast-iron segments each weighing about a ton, placed in position by a special erecting machine. All segments were machined at the joints and watertightness was ensured by the use of lead caulking. The $4\frac{1}{2}$ in. space between the back of the circular lining and the rock was then filled in with stone and a grout of cement and sand. Later on, the internal spaces of the segment were filled with concrete and finally finished with cream-coloured gypsum plaster sprayed with a transparent polish.

The roadway of reinforced concrete is built on a line a little below the horizontal diameter of the tunnel and is supported on two longitudinal reinforced concrete walls 21 ft. apart. These walls divide the lower portion of the tunnel into three sections, the centre one of which may perhaps at some future time be used for single-deck tram-cars, and two side passages, approximately triangular in section, which will be used for the supply of fresh air. The air will find its way into the tunnel through longitudinal ducts on either side of the roadway at the level of the kerb. Provision is also made for electric cables, water mains and drainage pipes.

The ventilation system was designed after full-scale experiments on a length of 1,000 ft. of finished tunnel using full-sized fans. These experiments were supervised by physiologists and ventilation experts, and they were also directed to ascertain which system would give the best results in the event of a serious petrol fire. As a basis, a traffic flow of 3,000,000 vehicles a year was assumed, and the plant as installed will ensure that, under normal conditions, the proportion of carbon monoxide will not exceed $2\frac{1}{2}$ parts in 10,000 parts of air, or 4 parts in 10,000 under extreme peak-load conditions. There are six ventilation buildings, three on each side of the river, with supply and exhaust fans, the whole plant including 30 fans with a total capacity of 10,000,000 cub. ft. of air per minute, each section of the plant being duplicated. Each ventilation building consists of a steel-framed structure with a central tower. In each case, fresh air will be drawn through intakes in the roof of the building by the supply fans and discharged into the air ducts, while the foul air will be drawn by the exhaust fans from the upper part of the tunnel and discharged up the central tower. All the fans are electrically driven and are remotely-controlled from the ventilation building at George's Dock, Liverpool, which will house the administration offices. The many other interesting features of this great undertaking include the pumping plant for dealing with water which may find its way into the tunnel, a system of lighting which does away with the necessity of cars switching on their head or side lights, fire and telephone stations and signals for instructing drivers to stop their engines. The cost of the whole scheme, including purchase of the land, has been about £7,000,000, towards which the Government made a grant of £2,500,000 from the Road Fund. Loans have been raised by the Corporations of Liverpool and Birkenhead which will be paid back out of the tolls and the rates. A fully illustrated account of this important work was given in *Engineering* of January 19, February 16 and March 16.

International Council of Scientific Unions

Meeting at Brussels

THE International Council of Scientific Unions (formerly the International Research Council) held its first triennial meeting, since its new statutes were adopted, on July 8–13 at Brussels. The general assembly of delegates met at the Palais des Académies, Brussels, and elected Dr. N. E. Nörlund, director of the Geodetic Institute, and Rector of the University of Copenhagen, president for the period 1934–37; General J. F. Bourgeois, of the Academy of Sciences, Paris, and Marchese Marconi, president of the National Research Council of Italy, were elected vice-presidents. Dr. Pelseneer and Dr. Went remain members of the executive committee, and Sir Henry Lyons the general secretary.

At this meeting for the first time, the International Unions of Astronomy, Geodesy and Geophysics, Chemistry, Scientific Radio, Physics, Geography and the Biological Sciences, attended as members of the Council, and communicated very interesting accounts of their activities in their respective scientific fields of work during the past three years.

For the first time also, addresses were given on scientific matters of general interest, and these included, on this occasion, one by Dr. D. la Cour on the International Polar Year, 1932–33, its aims, methods and some preliminary results; another by General G. Perrier, on recent international determinations of longitude; while Dr. E. P. Hubble spoke on the exploration of space, and Prof. H. R. Kruyt on electricity and hydration with colloids.

The International Committee on the Relationship between Solar and Terrestrial Phenomena was reappointed, and another on instruments and methods met to arrange its future procedure.

The following motion, put forward by the Royal Academy of Sciences, Amsterdam, was unanimously adopted by the General Assembly:

"The International Council of Scientific Unions, being aware of the fact that the present economic and political difficulties have brought humanity face to face with a number of the most complicated and dangerous problems and threaten to erect a system of barriers between various nations, expresses its deep faith that ultimately a way will be found leading towards a more harmonious economic structure, and wishes to stress the importance of maintaining by all means international co-operation in the

domain of science under whatever circumstances may present themselves.

"As laid down in its Statutes, the Council recognises the relations between pure and applied science. There is no doubt that both governments and industrial groups will in an ever increasing degree call upon scientists for elucidation of the manifold complexities and problems which human life and human relationship are presenting —problems, the most important of which perhaps are those of finding food, space in which to live and employment for the various peoples spread over the earth. If at the present moment an international organisation devoted to the solutions of these problems is still beyond our vision, and organisation constructed according to national systems must provisionally be strengthened for fear of losing hold of economic possibilities, it can be foreseen that the scientists of every country will be drawn more and more into these spheres of national organisation. The Council expresses its confidence that scientists, while giving their aid in meeting the needs of their own nations, will never lose sight of the international character of science as a whole, and will ever continue to keep in working order and to develop the connections necessary for international co-operation, even if severe shocks unhappily might come to threaten economic and political relations.

"In professing its faith in the possibility and the necessity of peace between the world's peoples, the Council points out that the "brotherhood of scientists" can be an important factor towards the establishment of a desire for mutual understanding and helpfulness in order to overcome the dangers involved in a too exclusive nationalism.

"The Council therefore, in emphasising the significance of science, both pure and applied, as a common treasure for all humanity, which can only be realised through a free-spirited co-operation of the most diverse elements, is of opinion that scientists of the whole world have a task of working for this understanding, and urges all allied organisations to give constant attention to this task."

The General Assembly accepted unanimously an invitation from the Royal Society to meet in London in 1937.

Obituary

Mme. Curie

MME. CURIE, whose death occurred on July 4 after a brief illness, held an outstanding position in science, for she had long been regarded as the foremost woman investigator of our age. Although her greatest scientific work, the discovery and isolation of radium, was done nearly thirty years ago, yet, as professor in the Sorbonne and director of the Radium Institute in Paris, Mme. Curie until the time of her death was actively engaged in researches on the physical and chemical properties of the radioactive bodies. At the same time, she was also director of a vigorous school of research which attracted investigators from many countries. During the last few years, she was engaged in preparing preparations of actinium much stronger than had previously been available, for the purpose of examining the fine structure of the α-ray groups emitted by the products of this element. With the help of her colleague, Dr. Rosenblum, and the use of the large Paris electro-magnet, many new results of importance were obtained.

Marie Sklodowska was born at Warsaw on November 7, 1867, and received her early education in that city. Interested in science, she resolved, notwithstanding financial difficulties, to go to Paris to perfect her scientific training, and took lectures and examinations in the Sorbonne. In 1895 she married Pierre Curie, a young physicist in Paris who was making those highly original and fundamental contributions to magnetism and crystallography so well known to every student to-day. The young couple joined forces in their scientific work, which was carried out initially under difficult conditions, for laboratory arrangements were poor, and both had to undertake much teaching to gain a livelihood.

The turning-point of the scientific career of Mme. Curie came as a consequence of the fundamental discovery of radioactivity by Henri Becquerel in Paris in 1896. He showed that the element uranium spontaneously emitted new types of penetrating radiation which darkened a photographic plate and discharged electrified bodies. This new discovery attracted the attention of Mme. Curie and, using the electric method as a means of quantitative analysis, she showed that the radioactivity of uranium was an atomic property. She also observed that the mineral pitchblende, from which uranium was separated, showed four to five times the activity due to the uranium alone. Since the activity of uranium was due to the atoms alone, this observation could only be explained by the presence of a new element or elements in the pitchblende much more active than uranium.

Boldly relying on this hypothesis, Mme. Curie made a systematic chemical analysis of pitchblende, using the electric method as a means of qualitative and quantitative analysis of the activity of her preparations. The first active element observed by these methods had properties allied to bismuth and was called polonium after her native country. She later discovered the presence of another element, happily named radium, which was similar in chemical properties to barium. We now know that radium is one of the long series of products of the radioactive transformation of uranium and exists in uranium minerals in about 1 part in 3 millions compared with uranium, and weight for weight shows an activity many million times that of uranium. The paper announcing this discovery was published in the *Comptes rendus* of 1898 under the names of M. and Mme. Curie and G. Bemont.

While at this stage, M. and Mme. Curie did all their scientific work together, it is natural to assume that Mme. Curie, as the chemist of the combination, was mainly responsible for the chemical work involved. She alone was responsible for the large-scale chemical work required to separate radium from radioactive residues in sufficient quantity to purify it and obtain its

atomic weight—a splendid piece of work for which she was awarded a Nobel Prize in 1911. It may be recalled here that Mme. Curie is the only recipient of a second award, for she shared a Nobel Prize with her husband and Henri Becquerel in 1904.

The discovery and isolation of radium was an event of outstanding significance to science from both the theoretical and practical points of view. The spontaneous emission of radiation from this element was so marked that not only was it difficult at first to explain but also, what was more important, still more difficult to explain away. The discovery of polonium and radium prepared the way for the ultimate explanation of radioactivity in terms of the spontaneous transformation of the radioactive bodies. Moreover, radium, in virtue of the radioactive emanation and other radioactive products into which it is transformed, has proved an invaluable source of great intensity for a study of the effects of the α-, β- and γ-rays in their passage through matter, and has thus played an important part in the growth of our knowledge of the internal structure of atoms in general. In addition, radium, in consequence of the highly penetrating γ-rays emitted from its products, has been widely used for therapeutic purposes and has proved an invaluable adjunct in the treatment of cancerous growths. Indeed, the greater part of the radium now separated on a commercial scale is utilised in the hospitals of the world for this purpose. Mme. Curie throughout her life actively promoted this use of her discovery to alleviate suffering, and during the War personally devoted herself to this remedial work—possibly at the expense of her own health.

Space does not allow me to mention more than a few of her numerous investigations in the field of radioactivity. She was for many years deeply interested in studying the chemical properties of the first element she discovered—polonium—and in developing methods for obtaining powerful sources of this element in the form of a thin film. Such active sources of polonium have proved of great use in later years in studying the transformations of matter by the action of α-particles, for the experiments are not complicated by the intense emission of β- and γ-rays which arise from sources like radium (B + C) and thorium (B + C). It was with the aid of these strong polonium sources that her son-in-law and daughter, M. and Mme. Curie-Joliot, have recently studied with such success the production of neutrons and induced radioactivity by the action of α-particles.

Mme. Curie retained her enthusiasm for science and scientific investigation throughout her life. She was an indefatigable worker and was never happier than in discussing scientific problems with her friends. All her publications are characterised not only by accuracy and skill in experimentation but also by marked critical power in the interpretation of the experimental results. Quiet, dignified and unassuming, she was held in high esteem and admiration by scientific men throughout the world, and was a welcome member of scientific conferences, in many of which she took an active part. She was a member of the Conseil du Physique Solvay from 1911 until her death. Since 1922 she had been a member of the Committee of Intellectual Co-operation of the League of Nations, and made many visits to Geneva.

The life of Mme. Curie was not without serious trials and tragedy, for her husband lost his life in a street accident in 1906. Immediately afterwards she was called to assume the directorship of the new Radium Institute named the 'Laboratoire Curie' which had been built specially for Pierre Curie and herself. She was made professor in the Sorbonne—the first time that a woman had gained this position. She was a clear and attractive speaker, and her lectures in the Sorbonne were widely attended not only by students of science but also by the educated public. In her later years, it was a source of pleasure and pride to her to watch the fine discoveries made by her daughter Irene and her daughter's husband in collaboration in her own laboratory. In a sense, history had repeated itself.

The importance of the pioneer work of M. and Mme. Curie in radioactivity was promptly recognised by the scientific world. In 1903, the Royal Society awarded them its Davy Medal. It is of interest to note that in 1903, M. and Mme. Curie came to London and M. Curie gave a lecture before the Royal Institution on the properties of radium. On this occasion, with the help of Sir James Dewar, the heat emission of radium at the low temperature of liquid oxygen was demonstrated for the first time. Mme. Curie was awarded numerous honorary degrees and was made honorary member of many societies both in Great Britain and abroad. In her last visit to England in 1929, she received the freedom of the city of Glasgow as well as an honorary doctorate of laws from the University. She was invited by the women of the United States to visit them in 1921; they presented her with a gram of radium in recognition of her discoveries, and in order to allow her to extend her investigations. She was everywhere received with great honour and repeated her visit in 1928.

The many friends of Mme. Curie throughout the world, who admired her not only for her scientific talents but also for her fine character and personality, lament the untimely removal of one who had made such great contributions to knowledge, and, through her discoveries, to the welfare of mankind.

RUTHERFORD.

We regret to announce the following deaths:

M. Benjamin Baillaud, honorary director of the Paris Observatory, and an associate of the Royal Astronomical Society, on July 8, aged eighty-six years.

Prof. F. W. Burstall, emeritus professor of mechanical engineering in the University of Birmingham, and vice-principal of the University in 1925–31, an authority on gas engines, on July 15, aged sixty-eight years.

News and Views

Progressive Industrial Chemistry

IN his presidential address to the Society of Chemical Industry at Cardiff on July 17, Dr. J. T. Dunn referred to the enormous growth of chemical industry since the early days of the Society. From being limited to the alkali industry, the soap industry, brewing and distilling, the metallurgical industries and, to a small extent, the manufacture of dyes it now covers not only great expansions and revolutionary developments in these industries but also the manufacture of synthetic drugs, the cellulose and plastics industries, the gas and coke industries, etc. One of the most potent factors in this change has been the growth of the idea that the chemist should have an authoritative position in regard to the conduct of a chemical industry. The idea that a chemist should be confined to the laboratory has largely passed, and chemists are now concerned not merely with routine testing of supplies and products but also with searching for improvements in processes and new directions for advance. They are as familiar with the details of the works as with the laboratory, and their opinion and advice are sought and regarded.

Fundamental Research

EQUALLY significant is the change that has taken place in the importance attached to research. Distinguishing between industrial or directed research and long-range investigations, Dr. Dunn, while stressing the value of the results obtained from the former which must always be carried on, stressed the value to industry of discoveries made in the first instance by men who are simply under the urge of inquiry into the working of Nature and have no industrial end in view. After citing a number of examples of important industrial developments based on such research, Dr. Dunn urged the encouragement of such fundamental investigations by competent staff both within industry and without, and pleaded for more determined effort to make known the scientific investigations which have made possible the sensational modern achievements in aviation, etc. When there is more wide-spread public appreciation of basic scientific work it will be easier to secure national support and recognition for chemical trading and research on a scale commensurate with their value to the nation.

Taxation and Scientific Research

IN an address recently delivered to the Association of Scientific Workers by its chairman, Mr. R. W. Western, attention was directed to the procedure in assessing income tax on commercial undertakings, whereby the position of scientific research as an aid in industry is seriously prejudiced. According to the present ruling of Inland Revenue officials, any expenditure on the scientific research incurred in connexion with a commercial or industrial undertaking is not counted as an expense which may be deducted from gross profits before assessment, but must be treated as capital expenditure and deducted from the amount available for distribution as dividend. Further, no allowance is made for depreciation of plant used in research, unless it is to be replaced—an obviously inappropriate condition. While it may be perfectly logical and in accordance with the strict principles of accounting to charge expenses of scientific research to capital, it offers a too obvious inducement to business concerns, when they have to meet their shareholders in these strenuous times to economise by cutting out research. In any event, it discourages co-operation between science and industry. Mr. Western's suggested 'Innovation Fund', free from tax, as a remedy for the situation has one feature which would be an undoubted advantage. This is the proposal that firms should publish particulars of their expenditure for purposes of scientific research, either singly or in groups. If to this could be added, without breach of confidence or revelation of trade secrets, some indication of the aims and achievement of such research, it would increase many-fold the interest of the general public in science. Information of this nature has always proved a readily absorbed item of news.

Scientific Research and Commercial Progress

LORD BLEDISLOE, in an address entitled "Some Reflections on the Economic Crisis" which he delivered to the Auckland Chamber of Commerce on May 31. 1934, said that whatever may be the ultimate remedies for the world's economic depression, no nation can anticipate assured participation in economic recovery unless it puts its own house in order by a policy of strenuous and persistent progress, an enlightened realisation of what is true economy, and an equitable and far-sighted assessment of the relative contribution to national wealth and popular well-being of all productive activities. First among the indispensable factors conducive to national prosperity are unflagging support of scientific research as applied to industrial production, distribution and transport, and systematic machinery for carrying ascertained knowledge, derived from such research and from the experience of successful enterprise, on to every farm and into every factory, mine, warehouse, shop and seaport throughout the country. Technical training has become more than ever essential to industrial success. A foreman or works manager will need in the future to know enough of science to appreciate intelligently, and be prepared to apply usefully, the work of the laboratory; and if he is to enjoy the sympathetic support of his employers, they too must have minds attuned to and biased in favour of scientific knowledge. Further, they must be prepared not only to encourage its prudent applications within their industrial ambit but also to make the voice of science more clamant in the councils of the nations.

To illustrate his thesis, Lord Bledisloe quoted the example of Denmark. Co-operation there has

not only been pursued in production, distribution and credit, thus eliminating a superfluity of handlings and middlemen's profits, but also the producers' organisations have taken over from the Government the task of controlling and directing the production, assembling, grading and exportation of butter, cheese, eggs and bacon. These processes have been thereby reduced to a fine art under the sympathetic supervision of a benevolent Government which has made science its watchword and consistently put a premium upon uniformity of output for export. It has preferred occupational community control rather than Governmental control in checking individual inefficiency. Of all the measures adopted to secure this objective, none has proved more salutary in maintaining a high average standard of husbandry than the system of peripatetic expert advisers, who periodically visit all the farms within their area and advise their occupants on the results of scientific investigation and the experience of others. The expenditure involved in providing for such advisory work is well worth while. To strengthen the backward, ignorant or inexperienced in some such way is the only sane alternative, since the ruthless abandonment to competition of weak human links has now fallen into disfavour.

Inland Water Survey

SIR HILTON YOUNG, the Minister of Health, who was accompanied by representatives of the various Departments concerned, received a deputation on July 17 from the British Association and the Institution of Civil Engineers. The deputation was introduced, in the unavoidable absence of Sir James Jeans, by Sir Henry Maybury, and there were present—Sir Percy Douglas, Sir Richard Redmayne, Prof. P. G. H. Boswell, Capt. H. McClean, Dr. Jeffcott and Dr. O. J. R. Howarth. The object of the deputation was to invite the Government to give favourable consideration to the institution of a complete and systematic survey of the water resources of the country, a subject on which a Committee of the British Association has recently published a report. The deputation suggested that the existing records both of surface water, including river run-off, and of underground supplies are very incomplete. They urged that systematic records comparable with those of rainfall are much to be desired and that a national survey is necessary in order to obtain statistics of this nature. Sir Hilton Young in reply thanked the British Association and the Institution of Civil Engineers for the consideration which has been given to the matter and for the suggestions which have been made, and said that these suggestions will receive the most careful consideration of the Government. He said that sources of information are available through the Ministry of Health, the Geological Survey and the Catchment Boards; and he suggested that the progress which is to be desired in the collection of statistics might perhaps be achieved by improving the existing means of gauging the flow of rivers and by improvements in the method of collecting and presenting returns.

Service Use of Petrol from Coal

UP to the present we have only touched the fringe of the possibilities presented by the production of petrol from coal, but the written reply given on July 11 by the Under-Secretary of State for Air to a question by Mr. Drummond-Wolff in the House of Commons is encouraging. Mr. Drummond-Wolff asked the Under-Secretary of State for Air the proportion of the total fuel consumption of the Royal Air Force which is fuel derived from British coal; whether it is intended to increase this proportion; and, if so, at what rate of increase. In reply, Sir Philip Sassoon said: "Seven squadrons are now flying on spirit derived from British coal, the consumption representing about seven per cent of the total quantity of aviation spirit used by the Royal Air Force at home. It is hoped to increase this proportion, but I cannot say at what rate it will be found practicable to do so."

Research in Abnormal Psychology

IT was suggested in a leading article in NATURE of December 23, 1933, that the scientific investigation of abnormal psychical phenomena might be undertaken in university departments or other institutions of learning in Great Britain. Particulars have now reached us of the formation for this purpose of a group, including some members of the University of London, under the title of the University of London Council for Psychical Investigation. The Council includes: Prof. F. A. P. Aveling, Dr. Guy B. Brown, Prof. Cyril Burt, Prof. J. C. Flugel, Mr. C. E. M. Joad, Mr. C. A. Mace, Prof. J. MacMurray, Dr. Eric D. Macnamara, Mr. S. G. Soal and Prof. E. S. Waterhouse. Mr. Harry Price, late director of the National Laboratory of Psychical Research, is the honorary secretary, and Miss Ethel Beenham (formerly secretary of the National Laboratory) has been appointed secretary. Through the generosity of Mr. Price, the new organisation has been equipped with the apparatus, instruments, workshops, records and research library belonging to his laboratory. We believe that the new Council is the first academic group in Great Britain formed to study the alleged phenomena of the séance room, and the first in any country to possess a laboratory specially equipped for the study of abnormal phenomena. The present address of the Council is 13D, Roland Gardens, South Kensington, London, S.W.7.

Ancient Monuments of Great Britain, 1933

IN accordance with their statutory obligation, the Commissioners of Works have published a list of protected ancient monuments which includes monuments added to those recorded in previous lists up to December 31, 1933 (London: H.M. Stationery Office. 1*s*. 3*d*. net). With a view to completeness, the Commissioners have included the names of monuments which are actually in their custody by deed of gift, deed of guardianship or by purchase. They are also responsible for other buildings or properties shown here which are not protected under the Act,

but are Crown property. The list now contains the names of no less than 3,600 monuments of all kinds, from prehistoric camps, stone circles and barrows to the remains of abbeys, castles, bridges, etc. Several of the buildings of historic interest are still in occupation, and Glasgow Cathedral and Dunblane Cathedral are also maintained by the Commissioners. Although, as is pointed out in an introductory note by the secretary to the Commissioners, the list cannot be regarded as complete or as covering systematically the whole of the more important ancient monuments of Great Britain, and although it is recognised that much has still to be done, it serves to indicate the wealth of antiquity that has been preserved, and the gratitude due to those who fifty years ago initiated the movement for the official preservation of historic monuments. In this connexion, however, and in view of the constant alarms as to the preservation of structures of historic interest in London, it may be noted that in Middlesex only two, and in London three, ancient monuments are recorded as under protection.

Civil List Pensions

AMONG the Civil List pensions just announced as having been granted on March 14 last are the following :—Mrs. Abbott, in recognition of the services rendered by her husband, the late Mr. W. J. Lewis Abbott, to geology and prehistoric archæology, £110 ; Mrs. Cantrill, in recognition of the services rendered by her husband, the late Mr. T. C. Cantrill, to prehistoric archæology, £60 ; Mrs. Hart, in recognition of the services of her husband, the late Dr. D. B. Hart, to gynæcology, £80 ; Mrs. Stapf, in recognition of the services rendered by her husband, the late Dr. Otto Stapf, to botanical science, £90.

Cattle Diseases and Milk Production

TOWARDS the end of 1932, a committee of the Economic Advisory Council was appointed by the Prime Minister to formulate measures to reduce disease among milch cows in Great Britain, for reducing bovine tuberculosis and for improving the milk supply, and to report upon any administrative changes that may be desirable. The report of this Committee, presided over by Sir Frederick Gowland Hopkins, has now been issued (Economic Advisory Council. Report of Committee on Cattle Diseases. London : H.M. Stationery Office. 2*s*. 6*d*. net). In the first part, the production and distribution of milk and their relation to cattle diseases and public health are considered. The second part is devoted to a discussion of possible lines of administrative development. In part 3 the Committee's various recommendations are set out in detail, and these with the principal conclusions are summarised in part 4. Owing to the ravages of disease, the useful life of a dairy cow, instead of extending over eight or nine lactations, averages only about 4½ years, the principal diseases causing this wastage being contagious abortion, tuberculosis, mastitis and Johne's disease.

THE effects of pasteurisation are surveyed, and the disadvantages are considered to be too small to outweigh the great advantage of protection from infection. Pasteurisation, however, should be permitted only in approved and tested plants, which should be frequently inspected officially by the sanitary authority during working. For the grading of milk, four new designations are suggested to replace those already existing. The principal measures proposed for improving the milk supply are (1) an extension of routine veterinary inspection, (2) an active policy for the eradication of bovine tuberculosis, and (3) the bestowal upon certain urban authorities of the right to require pasteurisation of all milk sold within their boundaries which is not either certified or grade A, tuberculin tested. Owing to variations in potency of commercial tuberculins, it is recommended that the Ministry of Agriculture and Fisheries should approve a standard for tuberculin, the product to be sold only to qualified veterinary surgeons.

Researches in Pathology

THE latest number of the *Journal of Pathology and Bacteriology* (**39**, No. 1, July, 1934), a handsome volume of some 250 pages with 52 plates, was issued on July 5 as a birthday greeting to Sir Robert Muir, professor of pathology in the University of Glasgow, on his seventieth birthday. Written entirely by his pupils, it is a fitting tribute to the widespread influence of the doyen of British pathology, and no other of our schools of pathology could have done the like for its revered leader. It contains nineteen substantial contributions to knowledge from a dozen different centres, and among the authors are ten professors of pathology or bacteriology. They cover roughly the whole range of subjects with which pathologists concern themselves. This is a far greater testimony to Sir Robert's power as a teacher than if his disciples were pursuing nothing but his own special interests. The Glasgow school and its leader are still as vigorous as ever, and everyone will wish them well.

The Colorado Beetle

AN article by Mr. J. C. F. Fryer in the *Gardener's Chronicle* of June 23, 1934, issues a note of warning about the possible spread of the Colorado beetle in Great Britain. For long periods our potato crops remained free from attack by this pest, and even when it appeared at Tilbury in 1901, it was quickly eradicated. Since the War, the beetle has established itself in France, and in August 1933 it re-appeared at Tilbury. Drastic measures to prevent its spread were taken immediately, and whilst it seems possible that they were successful, Mr. Fryer appeals to potato growers to maintain a careful watch for the conspicuous beetle. Partially eaten potato foliage suggests its presence, and close examination should be made for the insect. It has wing cases striped longitudinally with black and yellow, and is about half an inch long. That the pest has not yet established itself in Great Britain is a matter for congratulation, but continued freedom demands close co-operation from growers. Attacks in their early stages can be controlled with comparative ease, but when a colony is well established, it may have sent individuals to found other colonies.

St. Paul's School Field Club

THE fiftieth anniversary of the moving of St. Paul's School from the City of London to West Kensington, on the western border of Greater London, coincides with the opening of the new biological laboratories. The occasion was celebrated at Apposition on July 5, when the Field Club held an exhibition of its work. After the speeches, the display was visited by the High Master, the Governors of the School and many hundreds of boys and parents. The numerous exhibits indicated how wide are the interests of the members, in all branches of biology and natural history. Worthy of special mention were a large number of experiments in plant physiology, an investigation of irregular nutrition in plants (mycorrhiza, saprophytes and parasites), an ecological survey of sea-shore life and a study of heath and moorland associations, with special reference to mosses. Collections were shown of insects, ferns, seaweeds and fresh-water organisms, while a spirometer proved very popular. The Club, which is nearing its fortieth anniversary, has always been a great boon to the naturalists of the School, and in recent years has worked in close co-operation with the Biological Department. A great deal of field work is done, and in the winter, lectures are given by members and others on subjects of which they have made a special study. The Club is exceptionally fortunate in being at the same time within easy reach of the countryside and the authorities at the Natural History Museum, Kew Gardens and the Zoo.

Harvey and Literature

THE June issue of the *Proceedings of the Royal Society of Medicine* contains a paper read by Dr. D. F. Fraser-Harris before the Section of the History of Medicine on William Harvey's knowledge of classical, medieval, renaissance and contemporary literature. Harvey's acquaintance with classical literature is shown by the fact that his works contain references to twenty-five Greek writers ranging from Thales in the seventh century B.C. to Suidas, who flourished about A.D. 975, and including among others Hippocrates, Plato, Euclid of Megara, Erasistratus, Aristotle and Menander, as well as allusions to fourteen Latin writers from Virgil to Pipinus and Migaldus, including Varro, Terence, Seneca, the elder Pliny, Celsus and Ulpian. Three medieval writers are mentioned by Harvey, namely, Avicenna, Averroes and Albertus Magnus. Of the thirty-two renaissance and contemporary authors whom he quotes, the best known are Jacobus Sylvius, Fracastor, J. C. Scaliger, Fernel, Vesalius, Eustachius, Descartes, De Thou, Sennert, Pecquet, Baillou and Riolan. The only English writer mentioned is Francis Bacon, whose phrase "to enter upon our second vintage" is quoted in *De Generatione*. In the manuscript notes to his lectures, Harvey also cites seven authors whom he mentions nowhere else, namely, Plautus, Horace, Cæsar, Cicero, Vitruvius, Nicolas Massa and Archangelo Piccolhomini. Most, but by no means all, of the references are to subjects of biological importance, the exceptions being passages in the Eclogues, Georgics and Aeneid of Virgil and Terence's *Adelphi*. The conspicuous absence of any mention of Cæsalpinus, whom many Italian physiologists even to-day regard as the discoverer of the circulation of the blood, and of Servetus, in Harvey's writings is attributed by Dr. Fraser-Harris to the fact that all but three copies of Servetus's book had been burned with him at the stake and that Harvey had found nothing of real value in Cæsalpinus's work.

History of Organic Analysis

PRIOR to the introduction of elementary organic combustion analysis early in the nineteenth century, organic matter was analysed, over a period of nearly two centuries, by dry distillation, the results being expressed in weighed fractions of gaseous part, phlegma, oil and carbon residue, or later as carbonic oxide, carbonic acid, water, empyreumatic oil, acidic fraction, carburetted hydrogen and charcoal. The germ of this method is found in Beguin's "Élémens de Chymie", 1615. Nierenstein (*Isis*, **21**, 123; 1934) has shown that there was a period of transition between the old and new methods of analysis, represented by a work of Nees von Esenbeck, Bischof and Rothe, "Die Entwickelung der Pflanzensubstanz", Erlangen, 1819, a rare book which is otherwise of considerable interest in the history of plant chemistry This contains tables, from which the chemical formulæ may be deduced from the results of distillation analyses, containing 981 'complexions' of the five binary compounds of oxygen, hydrogen and carbon, namely, water, carbonic oxide, carbonic acid, olefiant gas and marsh gas. These tables were the precursor of Richter's percentage tables now widely used.

Wireless Communication and the Mercantile Marine

THE wireless communications of the mercantile marine are subject to regulations issued by the administrations of the maritime nations, which in turn are governed by the relevant parts of the General Radio Communication Regulations attached to the current International Telecommunication Convention which came into force on January 15, 1933. These regulations lay down the purposes for which the various bands of frequencies may be employed, certain bands being allocated exclusively to the mercantile marine, others to mobile services generally, while some are shared between mobile and other services. A certain amount of difficulty has been experienced in carrying out the communications of the mercantile marine owing to the interference which exists, especially in some areas near the coasts of Europe and the United States. In a paper read before the Wireless Section of the Institution of Electrical Engineers on May 2, Commander J. A. Slee made an analysis of the sources of this interference. Typical response curves of the average ship's receiver were given in the paper, and from these the field strengths of signals which can cause interference in the different sections of the marine communication band have been computed. The analysis dealt with both spark and valve transmitters, and also with the possible interference which

might arise from the large number of fixed beacon stations now in operation for the use of ship direction-finders. Although these beacons are located in a restricted band of wave-lengths, it has proved possible to utilise different modulation note frequencies, and it is considered that as at present organised, mutual interference between beacon stations is negligible.

Interference with Broadcast Reception

THE problem of the elimination of the interference caused to broadcast reception by electrical machines and apparatus is of widespread interest and is being studied in many countries. A Conference has been held in Paris recently under the auspices of the Electrotechnical Commission, at which representatives of various international electrical and broadcasting organisations were present. A brief report of the results of this Conference is given in *World Radio* of July 13. It was agreed that no protection need be considered at the present time for the case of a wanted signal strength of less than 1 millivolt per metre, and that the interference should be considered relative to a signal carrier wave of this intensity, modulated to a mean depth of 20 per cent. Under these conditions it was considered desirable, if reception free from interference is to be obtained, that the level of the interference field should be 40 db. below that of the wanted signal. At the present time, it would appear to be difficult and premature to fix a definite, practical value applicable to electrical installations, until further experimental data on this aspect of the problem have been obtained.

ONE of the difficulties accompanying legislation in this subject is the interpretation of the results of measurements of interference obtained by different methods. Three main methods are already in use in different countries for evaluating the relative magnitude of interference, these being known as the French, German and British methods respectively. At the Paris Conference it was agreed that a comparison of these three methods should be carried out in Berlin in October next by a group of five experts assisted by the General Secretary of the I.E.C., with the view of proposing that one of these or some alternative method should be adopted for international use. The British interests in this matter of interference reduction are safeguarded by the Radio Interference Committee of the Institution of Electrical Engineers in co-operation with the British Standards Institution, and these bodies were largely responsible for the success of the recent meeting in Paris.

Congrès Préhistorique de France

A CORDIAL invitation to attend the eleventh Prehistoric Congress of France is extended to all archæologists by its president and officers. The Congress is to be held at Perigueux on September 16–22. A special interest is attached to this meeting of the Congress, as it was at Perigueux thirty years ago that the Congress met for the first time. It had been constituted in the previous year on the proposal of MM. Émile Rivière and Marcel Baudouin, by the then recently founded Société Préhistorique de France. Its meetings were interrupted by the War and were resumed in 1931. The present session will be the first since that date. Apart from its sentimental interest, the meeting is of importance as taking place in the heart of the classical territory of prehistoric study, in which the evidence for the art and industry of palæolithic man abounds. It is appropriate, therefore, that the Conseil Général of la Dordogne will join with the Municipality of Perigueux in offering a welcome to members of the Congress. The Congress will meet under the presidency of Dr. Felix Regnault. The honorary general secretary and treasurer is M. Charles Schleicher, treasurer of the Société Préhistorique. The arrangements are in the hands of a strong local committee. So far as at present arranged, the subjects to which special attention will be devoted in the communications submitted to the Congress are the palæolithic period in the region of meeting, the mesolithic and neolithic of the Dordogne, and artificial caves and souterrains. The principal sites of interest in the area will be visited and excavations demonstrated in the course of the meeting. Notifications of desire to attend, subscriptions (Membre titulaire, 30 fr., Membre titulaire souscripteur, 100 fr., Membre adhérent, 20 fr.), communications, etc., should be addressed to M. Ch. Schleicher, 9, rue de Verneuil, Paris (vii).

Medical Aspects of Physical Culture

AN International Congress of Medicine applied to Physical Education and Sport will be held at Chamonix on September 3–5 under the presidency of Prof. A. Carnot of Paris. It has been organised by Prof. A. Latarjet, of Lyons, president of the International Association of Sport Medicine, as the result of a Congress held at Turin in 1933. The Congress will consist of the following sections with their special presidents : Biology (Prof. H. Laugier), Medicine and Pædiatrics (Dr. Jules Renault), Surgery and Orthopædics (Prof. L. Rocher), Physical Education during and after the School Period (Prof. Chaillet-Bert), and Sport Medicine (Prof. Grégoire). The following questions will be discussed before the united sections : biometrical standardisation of sport, medical control of physical education and sport, and medical indications for treatment at high altitudes. The object of the Congress is to secure the co-operation of biologists, clinicians and sportsmen and to further the scientific and social development of physical education. Further details of the Congress will be published later. The general secretaries are Dr. Godlewski, 14 rue Théodule Ribot, Paris, and Prof. Cordier, 1 rue Childebert, Lyons. The regional secretary is Dr. Agnel, Chamonix.

Faraday Society Discussion on Colloidal Electrolytes

A PRELIMINARY programme is now available of the General Discussion on Colloidal Electrolytes to be held by the Faraday Society at University College, London, on September 27–29. Prof. H. Freundlich will deliver an introductory paper, and papers in the remaining sessions will be grouped according as they

deal with theory, experimental technique or special subjects (soaps, dyestuffs, silicates, proteins, and so on). The papers, which will be available in advance, will be taken as read; each author will indicate a few points of special interest, after which the subject will be open for discussion. Among those outside Great Britain who are contributing papers are Dr. E. J. Bigwood (Brussels), Prof. P. Debye (Leipzig), Prof. E. Elod (Karlsruhe), Prof. A. Frumkin, Dr. Proskarnin and Prof. A. J. Rabinovith (Moscow), Prof. E. Hammarsten (Stockholm), Prof. H. R. Kruyt (Utrecht), Prof. Linderstrom-Lang (Copenhagen), Prof. A. Lottermoser (Dresden), Prof. J. W. McBain, Mrs. M. E. Laing McBain and Margaret M. Barker (Stanford University), Prof. W. Pauli (Vienna), Prof. M. Sameč (Ljubljana), Prof. A. Treadwell (Zurich) and Dr. F. Valko (Ludwigshafen a/Rh.).

Annals of the Transvaal Museum

THE Committee of the Transvaal Museum has just published, through the Cambridge University Press, indexes to all the volumes of the *Annals* from vol. 6 (1917–20) to vol. 11 (1924–26). The indexes are thorough guides to the systematic contents of the volumes, and show new genera, subgenera, species, subspecies and the main reference in heavy-faced type. But they do not contain authors' names or titles of papers contained in the volumes.

Announcements

THE Lord President of the Council has appointed Mr. E. Barnard to be director of food investigation in the Department of Scientific and Industrial Research, and Dr. F. Kidd to be superintendent of the Low Temperature Research Station, Cambridge. Both these posts were previously held by the late Sir William Hardy. Mr. Barnard has been assistant director of food investigation since 1931. He joined the Department of Scientific and Industrial Research on entering the Civil Service in 1919. Dr. Kidd, who has been on the staff of the Low Temperature Research Station since its establishment in 1922, has been engaged on food investigation work in the Department since 1918.

DR. MINORU MASHINO, a research chemist in the Tokyo Imperial Industrial Research Laboratory, has been awarded the medal for "special merit in research" of the Society of Chemical Industry, Japan. For many years, Dr. Mashino has made valuable investigations on the proteins of the soya bean.

THE Engineer's German Circle has arranged a tour of Germany to be held on August 30–September 7. Several places of technical interest will be visited. Further information can be obtained from the Amerop Travel Service Inc., 66, Haymarket, London, S.W.1.

IN a pamphlet of 30 pages, entitled "Practical Physiology of the Sense Organs", Dr. R. J. Lythgoe has aimed at collecting under one cover all the profitable exercises to be found in a scattered literature (Oxford University Press. London: Humphrey Milford, 1934. 1s. net). The author describes simple experiments on the sense organs which need a minimum of apparatus and preparation. The descriptions are as brief as possible, and are supplementary to the material found in theoretical textbooks. The total time required for the course is about 12 hours.

MESSRS. BERNARD QUARITCH, LTD., 11, Grafton Street, London, W.1, have issued Catalogue No. 489, "A Catalogue of Books and Periodicals on Aeronautics, Astronomy, Chemistry, Electricity, Engineering, Fortification and Gunnery, Horology, Mathematics, Meteorology, Mining and Minerals, Navigation, Physics, Pyrotechnics, Surveying, etc." This contains nearly 600 items. It includes many scarce and important early works on the mathematical and physical sciences, among which may be mentioned a first edition of Newton's "Principia"; the first English translation of Euclid's "Elements"; and early treatises on magnetism, by Peregrinus, Barlow and others. A number of valuable sets and long runs of important scientific periodicals are offered. These include the *Philosophical Transactions of the Royal Society*, complete and unabridged from the commencement in 1665 to 1933.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in mechanical engineering at the Harris Institute, Preston—The Principal (July 24). A lecturer in chemistry at the Leeds College of Technology—Director of Education, Leeds (July 24). A lecturer in electrical technology and power at the Municipal College, Burnley—Director of Education, Burnley (July 25). A principal of the Municipal Technical School, St. Helens—Education Officer, St. Helens (July 27). An assistant (Grade II) in the Admiralty technical pool for duty at the Admiralty Compass Department at Slough—Secretary of the Admiralty (C.E. Branch), London, S.W.1 (July 28). Eleven surveyors of works in the Military Engineer Services Establishment, India—The Under-Secretary of State for India, Military Department, India Office (July 28). Two assistant marketing officers in the Ministry of Agriculture and Fisheries—Secretary (July 30). An instructor in the Navigation Department, Merchant Venturers' Technical College, Bristol —Principal (July 30). A lecturer in mechanical engineering at the Municipal Technical College, Hull—Director of Education, Hull (Aug. 1). A lecturer in mechanical engineering at the Municipal Technical College, Hull—Director of Education, Guildhall, Hull (Aug. 1). A principal of the Carlisle Technical School—Director of Education, Carlisle (Aug. 8). A principal of the Widnes Municipal Technical College—Secretary, Education Office, Town Hall, Widnes (Aug. 31). A reader in industrial hygiene and medicine in the University of Birmingham—Secretary (Sept. 1). Full-time appointments in engineering subjects at the County Technical College, Mansfield, Notts—The Principal. A mechanical draughtsman on the Singapore Harbour Board—Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M/3446.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Possibility of Sedimentation Measurements in Intense Centrifugal Fields

THE ultracentrifugal technique worked out in this laboratory enables us to carry out measurements of sedimentation velocity and sedimentation equilibrium in very powerful centrifugal fields[1]. At the present time, routine work can be done at speeds up to 74,000 r.p.m. with a column of solution 12 mm. in height situated 65 mm. from the centre of rotation. The centrifugal force in this case corresponds to 400,000 times gravity. When it comes to the study of substances of comparatively low molecular weight, for example, 1,000 or 2,000, and when one wishes to make a sedimentation analysis of mixtures of low molecular weight, such as the decomposition products of the proteins, it is of importance to have at one's disposal centrifugal fields of still higher intensity. We have therefore tried to improve our technique in this direction.

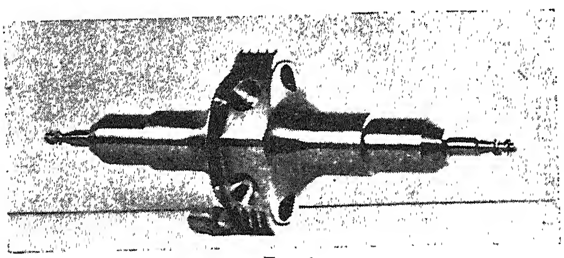

FIG. 1.

Rotor (weight 2,500 gm.) and cell (weight 12·5 gm.) for sedimentation measurements up to 900,000 times the force of gravity; the two twin-turbines at the ends of the shaft are fed with oil at a pressure of 15 kgm./cm.^{2}; the rotation takes place in hydrogen of 20 mm. pressure.

Last autumn a rotor was made for carrying a cell containing a column of solution 6 mm. in height at a distance of 36 mm. from the centre of rotation. It was successfully tested at 135,000 r.p.m. (750,000 times gravity) but exploded later, during a run at 125,000 r.p.m. (625,000 times gravity). The experiment showed, however, the possibility of regular sedimentation measurements at this speed. This spring, a new rotor of about the same dimensions, but of better material and improved construction, was therefore designed for a cell carrying a column of solution 8 mm. in height at 36 mm. from the centre of rotation (Fig. 1). It was tested at 160,000 r.p.m. (1,100,000 times gravity) and successful runs on hæmoglobin were carried out at a speed of about 145,000 r.p.m. (Fig. 2). The rotor finally exploded during one of these runs.

The fact that the cell with its windows of crystalline quartz withstood the strains and that convection-free sedimentation was obtained shows that accurate measurements may be performed in centrifugal fields of the order of one million times the force of gravity. We feel sure that it will be possible to improve further the mechanical design and to utilise to advantage the convection-free sedimentation which has been demonstrated to take place even in these very intense centrifugal fields under the experimental conditions realised in our ultracentrifuge.

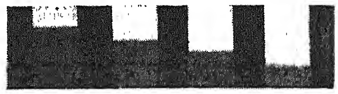

FIG. 2.

Sedimentation of dilute human hæmoglobin in the centrifugal field 900,000 times the force of gravity; time between exposures—3 minutes; the sharpness of the boundary between solvent and solution demonstrates the perfect homogeneity of this protein.

THE SVEDBERG.
GUSTAV BOESTAD.
INGA-BRITTA ERIKSSON-QUENSEL.
Laboratory of Physical Chemistry,
University of Upsala,
Upsala, Sweden.
June 21.

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Fluorescent Yield of X-Ray Emission

ONE of the chief reasons for the low intensity of the X-ray lines emitted by light atoms is the low fluorescent yield of the X-ray emission by such atoms. As predicted by Rosseland and first shown by Auger, excited atoms when reorganising can dispose of their excess energy either by emitting X-ray quanta or by giving off photoelectrons. When the latter process prevails, the yield of X-ray emission is low, and vice versa. The magnitude of the yield can be determined by counting the number of photoelectrons[1] given off by the atoms when leaving the excited state, or by comparing the intensity of the exciting and the excited radiation.

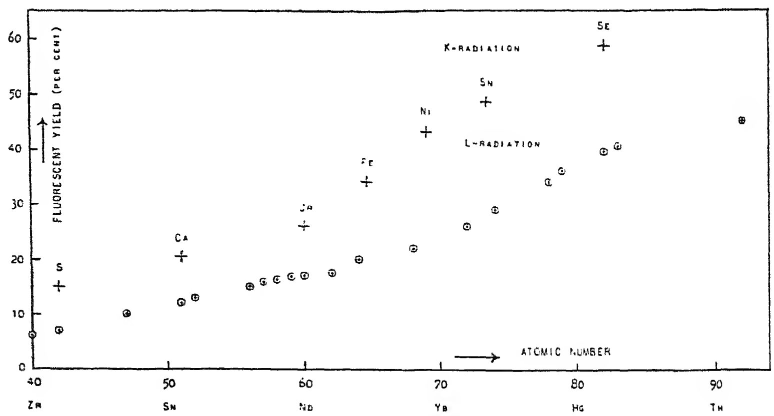

FIG. 1. *L*-radiation yield of the elements 40–92. The graph also shows the *K*-yield of the elements emitting a *K*-radiation of corresponding wave-length.

It was chiefly the last-mentioned method which was used to determine the fluorescent yield of the K-emission in numerous cases[2], the intensities being measured by the ionisation method. We determined the fluorescent yield of the L-emission of a great number of elements and that of the K-emission for several cases by using a photographic method worked out by E. Alexander and one of the present writers[3].

The results obtained are to be seen from Fig. 1, which shows an increase from 6 to 45 per cent of the fluorescent yield of the L-radiation when proceeding from zirconium (40) to uranium (92). In the same graph some values found for the K-radiation yields are also plotted.

When a K- and an L-radiation of equal wave-length are compared, the yield of emission is markedly greater in the first case, the ratio being as much as 1·75 : 1, for the wave-length 3300 X.U. We determined also the M yield in the case of uranium and found it to be 6 per cent. The comparison of the fluorescent yield of the K-radiation of potassium with that of the L-radiation of silver and the M-radiation of uranium, all these radiations having about the same wave-lengths, shows the ratio 18 : 10 : 6.

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June 15.

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[2] Comp. especially L. Martin, *Proc. Roy. Soc.*, A, **115**, 420; 1927. A. H. Compton, *Phil. Mag.*, VII, **8**, 961; 1929. G. L. Locher, *Phys. Rev.*, **40**, 484; 1932. M. Haas, *Ann. Phys.*, **16**, 473; 1933. D. K. Berkey, *Phys. Rev.*, **45**, 437; 1934.
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Polarisation and Spectrum of the Sky Light during the Total Solar Eclipses of August 31, 1932, and February 14, 1934

EARLIER observations of the polarisation of the sky light during solar eclipses do not agree[1]. New observations were undertaken in connexion with my polarisation measurements of the solar corona. I observed, during the 1932 eclipse at Gray, Maine, a point of the sky at a distance of 8° from the sun at mid-totality. A Martens polarisation photometer was used, mounted rigidly. The sky was perfectly clear. Whereas comparison curves obtained on several days before and after the eclipse show smooth curves, the polarisation curve of the eclipse day reveals a considerable *increase of polarisation* during totality. These measurements were repeated during the 1934 eclipse observed at Losap Islands, in the South Seas. Again a point was observed at a distance of 8° from the sun at mid-totality. A half-shadow polarimeter was used. The sky was perfectly clear. The results obtained show again the increase of polarisation during totality against the comparison days.

The *plane of polarisation* of the 8° point shows a smooth change during the comparison days, according to the position of the sun. During totality, however, a *rotation* of the plane was observed amounting to several degrees from the strictly radial polarisation observed otherwise.

In 1934, thirteen spectra were taken of the sky light before, during, and after the eclipse on two backed Agfa Superpan plates. A Hilger grating spectrograph was used (dispersion 49·4 A./mm.), the instrument being pointed towards the same 8° point of the sky as the polarimeter. The spectrograph was carefully protected against light from other parts of the sky. Intensity squares and comparison spectra were printed for photometric reduction of the plates, both with a neutral and a step wedge. Comparison spectra of the sky light were taken during two days. Microphotometer records of the spectra show a good agreement in the intensity distribution, except in those spectra obtained shortly before and after totality, the spectrum obtained during totality being too faint for accurate measurement. The spectrum before totality reveals the appearance of a *new maximum* extending photographically from 5910 A. to 6150 A. This maximum seems to appear also in the spectrum after totality. A second new maximum appears faintly in the spectrum before totality in the region 4610–4700 A.

It seems worth while to check this change of the spectrum of sky light in future eclipses, using glass and quartz spectrographs of higher light power. A confirmation of the new maxima would, together with the rotation of the plane of polarisation, point to the presence of a self-luminescent component in the sky light, besides scattered light of the sun according to the Tyndall–Rayleigh law. The self-luminescence may be explained by electron impact of gases of the atmosphere such as has been shown under laboratory conditions[2].

I am obliged to Profs. A. C. Hardy of Massachusetts Institute of Technology, and C. L. A. Schmidt of the University of California, and to Mr. H. Spindler of San Francisco, for loan of instruments, to Mrs. R. N. Mayall of Harvard College Observatory, Mrs. W. M. Cohn, and Mr. T. Hirai, of Kyoto Imperial University, for assistance. The 1932 work was supported by grants from the Rumford and Permanent Science Funds of the American Academy of Arts and Sciences. The Imperial Japanese Government kindly furnished transportation facilities to and from Losap Islands, and extended many courtesies to the 1934 expedition.

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Berkeley, California.
May 9.

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[2] W. M. Cohn, *Z. Phys.*, **75**, 544; 1932.

Atomic Radius of Fluorine

FOR reasons explained in a forthcoming paper, I suggest the use of the term 'di-atom' in place of 'diatomic molecule' in spectroscopic nomenclature.

By an application of the modified Morse formula[1], I have 'predicted' the equilibrium nuclear distances of 36 electronic levels of non-hydride di-atoms. It is hoped to apply these results in the construction of potential energy-nuclear distance curves.

The equilibrium nuclear distance of F_2 (in $^1\Pi$ state*) is found to be 1·331 A., giving an atomic radius of 0·67 A. This is in exact agreement with W. L. Bragg's original estimate[2], from crystal data, whilst a more recent value, due to Neuberger[3], is 0·68 A.

The agreement between experiment and calculation appears somewhat striking, especially when the two following facts are taken into account: (1) The value of ω_e on which the calculation is based refers to band-head measurement[4]; (2) extrapolation is involved from the 12th to the 14th molecular group. The modified formula thus appears to survive a sufficiently severe test.

* The lowest state for which measurements are recorded.

I have also found the modified expression to be applicable to hydride di-atoms in the period from LiH to FH. Morse's function, far from remaining constant, is definitely periodic in the earlier periods of both hydride and non-hydride di-atoms.

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[1] C. H. Douglas Clark, NATURE, 133, 873, June 9, 1934.
[2] W. L. Bragg, *Phil. Mag.*, vi, 40, 169; 1920.
[3] N. V. Sidgwick, "The Covalent Link in Chemistry" (Cornell University Press, 1933) (see Table XVIII on p. 85).
[4] W. Jevons, "Report on Band-spectra of Diatomic Molecules" (Cambridge University Press, 1932) (see Appendix II, p. 280).

L Absorption Spectra in the Very Soft X-Ray Region

THE L_{III} absorption edges of aluminium and magnesium have been measured. Since the continuous X-ray spectrum in this region (above 100 A.) is very feeble, I have used optical spark spectra from elements giving spectra rich in lines. As source for the spectra reproduced in Fig. 1 a spark between copper electrodes was used. The apparatus was a concave grating spectrograph with a glass grating, ruled at this laboratory, of radius 1 m., 288 lines per mm.

a
b
c

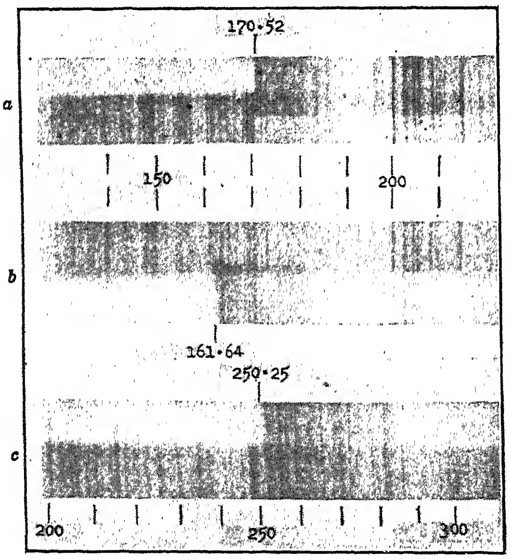

FIG. 1. L_{III} absorption limits of (*a*) Al, (*b*) Al in Al_2O_3, and (*c*) Mg.

The thickness of the foils used was for aluminium $0 \cdot 5\,\mu$ and for magnesium about $0 \cdot 3\,\mu$. The magnesium was deposited on a $0 \cdot 5\,\mu$ aluminium foil. The wavelengths for the copper lines in this region being known[1], the edges were measured relative to those lines. The L_{III} absorption limit of Al was found to be 170·52 A., giving $\nu/R = 5 \cdot 344$. The corresponding value for Mg was 250·25 A., $\nu/R = 3 \cdot 641$.

I have also measured the L_{III} absorption edge of Al in Al_2O_3 (Fig. 1, *b*). The value found is 161·64 A.

A detailed report will be given elsewhere.

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[1] Kruger and Cooper, *Phys. Rev.*, 44, 826; 1933.

Heat Flow during Surface Colour Formation

WHEN gaseous substances slowly react with metals, and the volume of the solid resultants is greater than that of the metal at the temperature of reaction, a series of bright interference colours is generally produced. Some anomalous features are shown, however, when the dynamics of the formation of the films are considered, and occur generally independently of the gaseous reagent and the nature of the solid metal. The rate of formation slows down faster than described by the laws of diffusion through a thickening film at constant temperature, and, further, if the gaseous reactant be removed, causing the interruption of the reaction, the speed at which the reaction re-occurs diminishes. The longer the time of arrest the more marked is the slowing down, and in some cases, for example, temper colours on steel, the colour appears to be fixed.

The molecular heat evolution in this type of reaction is large, but the films are so thin that ordinary methods fail to detect the heating, and in reactions at room temperature the film is cold if touched. While the reaction is proceeding, the film is separated from the metal by an interface at which the heat evolution is proceeding, and a partition of the heat evolved occurs, the metal taking most by reason of its large thermometric conductivity. On account of the relatively enormous mass of the metal, it appears little altered in temperature. The interference film is thin, and the heat remaining in it, though much less than that flowing into the metal, produces a marked elevation of the temperature while the film is forming.

The order of the effect for iron, nickel and copper, when one oxide colour sequence is produced in about two minutes, is 20° C. for copper oxide, 50° C. for nickel oxide, and 90° C. for an iron oxide film. Thus the diffusion of the reactants through the oxide film is cut down by a purely physical cause if the reaction be arrested, since the film can then attain the temperature of the mass of metal relatively quickly. In each case after interruption the same velocity can only be attained again by raising the temperature, and the rise in temperature necessary after a considerable interruption is of the same order as the original elevation of the temperature of the film before the reaction was stopped.

In the same way, the dynamics of the slow attack of gaseous reagents on metals is complicated by the initial higher temperature of the interference film falling when the rate of evolution of heat at the interface becomes comparable with the rate of flow of the heat stored in the interference film through the massive metal. The fall of the velocity under these conditions is thus autocatalytic, and affords a ready explanation of the fact that sometimes experience leads to the association of a definite colour of the final film with a definite temperature for the plane surfaces of massive metal. The greater the molecular heat of reaction, and the smaller the difference between the thermometric conductivity of the metal and the interference film, the more noticeable becomes the fixed colour at a fixed temperature in the range of temperatures in which the attack is slow.

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Magnetic Properties of Benzene Vapour

FROM a theoretical point of view it may be expected that the molecular susceptibility of benzene will remain almost unaltered when the substance passes from the liquid to the vapour state. The available experimental data show, however, a distinct divergence between the susceptibility values of those two aggregate states of benzene. While the molecular susceptibility of the liquid as measured by Pascal and others is equal to 57×10^{-6}, the data obtained by Vaidyanathan[1] for the vapour state reach 83×10^{-6}. The difference between the two values, as, for example, pointed out by E. C. Stoner[2], is much too great to be accounted for by the adopted model of the benzene molecule.

As the values of the susceptibility of the liquid obtained by different authors agree very well with the value given by Pascal, it seemed to us necessary to repeat the measurements on benzene vapour only. A new method recently developed in this laboratory[3] permitted us to make absolute measurements of the susceptibility of different gases and vapours with a sufficiently high precision. We investigated the magnetic properties of benzene vapour carefully dried and purified *in vacuo*. The value of the susceptibility of the vapour obtained by us is equal to $59 \pm 3 \times 10^{-6}$. This agrees very well with that adopted for the liquid, namely, 57×10^{-6}.

Thus it seems that the difficulty concerning the magnetic properties of benzene was mainly based on some mistake in the experimental work. Our measurements are being continued, and we hope shortly to publish elsewhere more precise data concerning this problem.

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[3] *Comptes rendus de l'Academie des Sciences de L'URSS*, in print.

Fluoride as an Impurity in Sodium Phosphate

SINCE fluoride has a strongly inhibiting effect on many enzymes, its unsuspected presence, even in small amount, may cause serious disturbance in biochemical work. It may be well, therefore, to direct the attention of biochemists to the fact that some samples of sodium phosphate contain fluoride. Recently in this laboratory it was found that a specimen of 'sodium phosphate recryst', purchased in the ordinary course as a reagent, strongly inhibited alcoholic fermentation by dried yeast. On examination it was found that fluoride was present in sufficient quantity to be easily detected qualitatively. Judging by its biochemical effect, about 0·1–0·5 per cent of fluoride (as sodium fluoride) must have been present in the sodium phosphate, but no quantitative chemical estimation was made. A single crystallisation of 25 gm. of the salt from 100 ml. of water gave a product which reacted with yeast and sugar in the normal manner.

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Kinetic Measurements with the Pulfrich-Stufenphotometer

IF a chemical reaction takes place with change of colour, colorimetric measurements at time intervals form a convenient method for examining the kinetics of the reaction. It is possible to improve the older methods[1] based on this principle by the use of the Pulfrich-Stufenphotometer by Zeiss. This instrument permits of measurements: (1) at constant temperature; (2) for a large range of concentrations; (3) with monochromatic light; (4) in coloured and very volatile solvents.

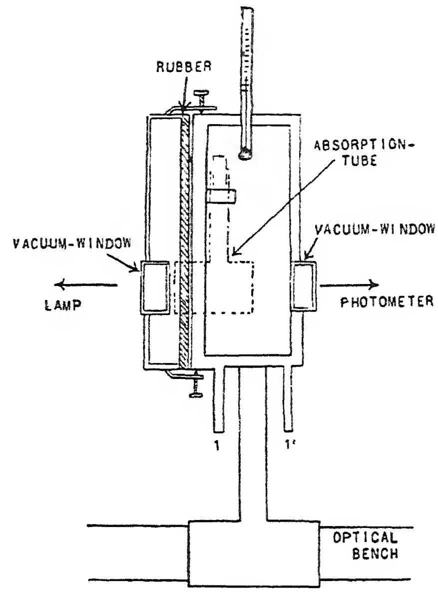

FIG. 1.

Absorption tubes up to 4 cm. in length were kept in an air bath (Fig. 1). Those of greater length were surrounded by a water jacket (Fig. 2)[2]. It is easy to get constant temperatures ($\pm$ 0·05°) in the range 0°–80° by pumping water from a thermostat through 1–1′ and 2–2′ in Figs. 1 and 2.

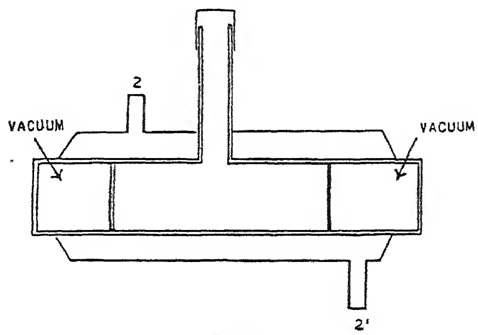

FIG. 2.

As the thickness of the absorption tubes can be varied from 0·1 to 100 cm., the range of concentrations in which measurements can be made is very wide, and it is also possible to work with both highly coloured and weakly coloured substances.

The *S*-filters of the instrument permit of measurements with approximately monochromatic light of wave-lengths 470, 500, 570, 610, 720 and 750 mμ.

The use of comparison absorption tubes containing the pure solvent automatically compensates for the colour of the solvent itself.

When volatile solvents were used or when measurements near the boiling point of the solvents were carried out, the absorption tubes were provided with double-ground stoppers[3].

The method just described was used to investigate the kinetics of a 1–4 addition to conjugate double-bonds (diene-synthesis) which will shortly be reported.

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[2] cf. V. Henri and H. de Laszlo, *Proc. Roy. Soc.*, A, **105**, 670 (Fig. 2); 1924.
[3] A. Smakula, *Z. phys. Chem.*, B, **25**, 94 (Fig. 3); 1934.

Spectrophotometry of Rapidly Changing Systems

MANY methods of rapid spectrophotometry have been devised. These have all been directed towards: (1) lessening the time required to obtain a record of the absorption; (2) decreasing the time interval between successive records; (3) decreasing the time required to evaluate records.

No method so far devised has fulfilled these requirements to such a degree that a full record of a change in absorption occupying less than 30 sec. can be obtained at succeeding intervals. The methods of Philpot and Schuster[1] and the methods described by Twyman[2,3] approach nearest to the ideal requirements.

By a simple application of the cathode ray oscillograph, we have been able to obtain a continuous representation of the absorption curve of a changing system, the time response being less than 1/50 sec. A series of slits are made to travel along the focal plane of a spectrometer. The slits are arranged at such intervals that the spectrum is always and only 'scanned' by one of the slits. As one slit leaves the spectrum, the next enters. The light traversing a slit is collected and falls on the cathode of a photocell. The photoelectric response is amplified and connected to the plates in the vertical axis of a cathode ray oscillograph. The horizontal component is actuated by a time base circuit synchronised with the passing of a slit across the spectrum.

The resultant of the two applied potentials, the excursion of the spot, is a representation of the variation of photoelectric response with time, or, if the synchronisation be perfect, with wave-length.

The photoelectric response for any given wave-length depends on the energy of the light at that wave-length, and the sensitivity of the photoelectric cell for that wave-length. The slits are made to traverse the spectrum at 20–200 times per sec. and the shape of the standing curve is the resultant of these two factors.

Should a solution placed before the collimating lens of the spectrometer possess an absorption band, a depression in the curve appears, corresponding to that portion of the spectrum absorbed. The wave-length of the absorbing region can be determined by means of a fine cursor wire which can be moved along the focal plane of the spectrometer by means of a scale calibrated in wave-lengths. The exceedingly sharp inflection on the curve caused by the shadow of the cursor wire can be moved to coincide with any required portion of the curve, and the wave-length read off from the scale. Any shift of the absorption band can be followed visually or cinematographically.

There are obvious difficulties in making the measurements of transmission quantitative. The wide variation of sensitivity of the photoelectric cell with wave-length and the distortion of the response by the amplifier are the chief difficulties, and it cannot be claimed that these have been overcome. The amplifier in use has a 4-stage resistance-capacity coupled circuit, designed to respond to frequencies from 100 to 10,000. It is probable that a wider range of response than this would be required to follow the steep intensity gradients of fine structure in some absorption bands. The principle is applicable to the ultra-violet or visible regions of the spectrum, though, so far, measurements have not been carried below the limit of transparency of glass.

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[1] Med. Res. Coun. Special Report Series, 177; 1933.
[2] *Trans. Opt. Soc. Lond.*, **33**, 9; 1931.
[3] *Proc. Phys. Soc. Lond.*, **45**, Pt. 1; 1933.

Electric Impedance of Suspensions of Yeast Cells

THE electric impedance of suspensions of yeast cells, suspended in solutions of electrolytes, has been measured as a resistance, R, and a parallel capacitance, C, with a Wheatstone bridge. In Fig. 1 are shown C and R, as functions of frequency, for a 63 per cent suspension of yeast cells in a 0·1 per cent sodium chloride solution. The form of the curve for C is interesting, particularly when it is compared

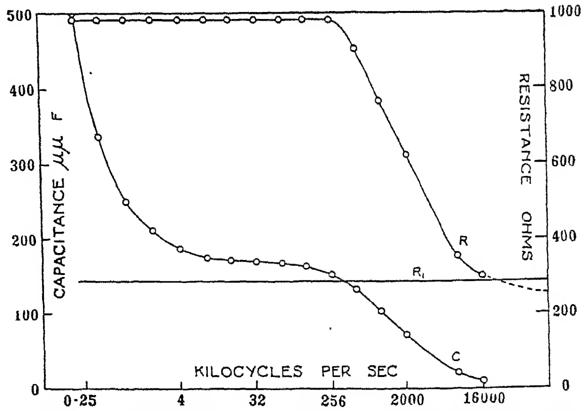

FIG. 1. Resistance (R), capacitance (C) and resistance of suspending fluid (R_1) for a 63 per cent suspension of yeast in 1 per cent sodium chloride*.

with the curve usually obtained for tissues[1], for it seems that it provides evidence regarding characteristics of the cell surface which may be obscured in the case of tissues by reason of their lack of homogeneity. For suspensions of red blood corpuscles, curves[1] have been obtained similar to those for yeast, although the increase of C at low frequencies is of much smaller magnitude.

Up to a frequency of about 128,000 cycles per second, the conductance of the yeast cell is very low compared with that of the suspending fluid. Over this range of frequencies, the impedance is derived from the surface of the cells (as well as from the suspending fluid) which acts as a complex impedance with a large capacitative component and a small phase angle. The drop in C and R at 128,000 cycles is considered to represent the point at which the impedance of the cell surface has been lowered sufficiently to allow an appreciable part of the current to pass into the cells. The nearly constant value of C at frequencies between 16,000 and 128,000 cycles is interesting. Within this range, C is also independent of the suspending fluid, as shown in Fig. 2, which shows C and R for 63 per cent suspensions of yeast in different concentrations of sodium chloride.

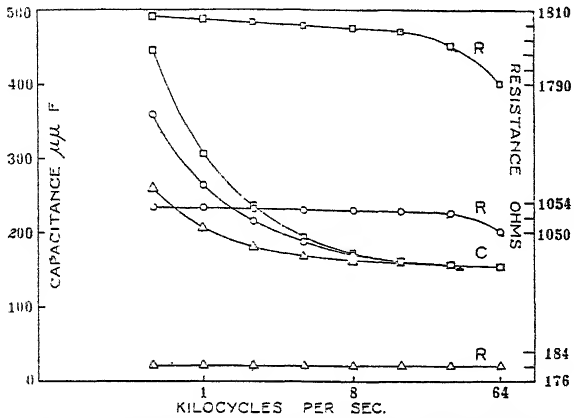

FIG. 2. Resistance (R) and capacitance (C) for 63 per cent suspensions of yeast in different concentrations of sodium chloride; R_1 is resistance of suspending fluid*.

□, 0·01 per cent sodium chloride, R_1 = 513 ohms.
○, 0·1 ,, ,, ,, ,, R_2 = 299 ,,
△, 1·0 ,, ,, ,, ,, R_3 = 53 ,,

* By the test of the electric conductance, the yeast cells are in equilibrium with 0·25 per cent sodium chloride. When the concentration of the suspending fluid is different from this, there is a slow change in the conductance of the suspending fluid.

In interpretation it may be assumed that, in this range of frequencies, the impedance at the surface of the yeast cell is derived from a poorly conducting membrane which acts as a static condenser. The increase of C and R at lower frequencies may be due to the polarisation of a slight conductance current through the membrane. Polarisation would be expected to occur if the permeability of the membrane were different for anions and for cations and the polarisation would be larger in the more dilute solutions.

The static capacitance per square centimetre of membrane can be calculated to be 0·6 μF at 16,000 cycles. Taking arbitrarily the dielectric constant of the membrane as 3, this capacitance would correspond to a thickness of 40×10^{-8} cm. This value is slightly larger than that found for the red blood corpuscle[2], although the difference scarcely exceeds the experimental error.

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[1] H. Fricke, Cold Spring Harbor Symposia on Quantitative Biology, 1, 117; 1933.
[2] H. Fricke and S. Morse, *J. Gen. Physiol.*, **9**, 137; 1925.

Active Principle of the Amphibian Organisation Centre

IT has been shown (Waddington, Needham and Needham[1]) that the active principle of the amphibian organisation centre (the evocator) can be extracted with ether or petrol-ether from either larval or adult tissues. This has since been confirmed by Fischer and Wehmeier[2]. We have now proceeded some way with the purification of the crude extracts prepared from adult newts or calves' liver.

The fractions to be tested were emulsified in egg albumen which was then coagulated, and small lumps of the coagulum were implanted into the blastocœl of newt gastrulæ. The crude extract was first saponified and it was found that the unsaponifiable fraction, when implanted in the above manner, was capable of inducing neural tissue, either in the form of tubes or of large flat plates (palisade inductions). From the unsaponifiable material, a further fraction was separated by precipitation with digitonin, this reagent being then removed; the active material is present in the precipitate, and seems to be absent in the filtrate. Further purification is in progress.

Fischer and Wehmeier[3] obtained inductions by the implantation of glycogen, and claimed that glycogen is actually the active principle of the organisation centre. However, after the publication of Waddington, Needham and Needham's results, they undertook[2] a purification of their glycogen, and showed that it was possible to obtain inactive preparations. We have performed the converse experiment: starting with specimens of glycogen prepared by Pflüger's or Kerly's methods, we were able to extract active substances with ether. This shows that some, if not all, of the activity shown by Fischer and Wehmeier's specimens of glycogen is to be accounted for by the presence of impurities; and further, since the preparation of the glycogen involves boiling with alcoholic potash, it is also good evidence for the unsaponifiability of the evocator.

We have also made implantations of certain synthetic compounds belonging to the phenanthrene group, kindly supplied by Dr. J. W. Cook, of the Cancer Research Hospital. Most of the implants call forth only an undifferentiated cellular proliferation, like the sterols implanted last year (Needham, Waddington and Needham), but in a few cases, induction of neural tissue has occurred. Typical neural tubes have been induced by the two substances 9 : 10.dihydroxy-9 : 10.di-*n*-butyl-9 : 10.dihydro-1 : 2 : 5 : 6 dibenzanthracene and 1 : 9.dimethylphenanthrene. These are the first synthetic substances which have been shown to possess inducing powers. This behaviour seems to us additional evidence that the naturally occurring evocator belongs to some group of sterol-like compounds.

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Phototropism in *Porcellana* Larvæ

VARIOUS explanations of the interesting phenomena classed as 'tropisms' have, from time to time, been put forward; ranging from Loeb's completely mechanical hypothesis[1] to the point of view of Russell[2], who maintains that what we see is the attempt of the animal to escape from an unusual situation; he calls this a 'flight response'.

Neither of these points of view is entirely satisfactory. It is not clear why the nature of a 'flight response' should vary with, say, the temperature, as it must in those cases where the sign of phototropism is changed by a slight rise in temperature; and, again, 'flight response' does not appear to fit in with Clarke's important work on *Daphnia*[3].

Loeb's theory of response to light which he called the "Muscle Tension Theory of Heliotropism" (*loc. cit.*, p. 54) has had to be modified in the light of work[3] which has shown that orientation is based on a mechanism entirely distinct from that of certain other aspects of phototropism. As a rule it is difficult to distinguish between (1) movement and (2) orientation, in respect to light; but the larvæ of *Porcellana* give a good example in which these processes are distinct.

The reactions of *Porcellana* larvæ to light have been described by Spooner[4]. He concluded that the behaviour of these larvæ was to be classed as 'phototopotaxis', by which term he indicates a "special type of phototaxis in which the direction of movement is controlled by the direction of the light rays".

Spooner also observed that these *Porcellana* larvæ sometimes move backwards, instead of forwards, to the source of light. It has been shown elsewhere[5] that if a *Porcellana* larva is swimming normally towards the source of light and then the direction of light is suddenly reversed, the larva, instead of re-orientating itself to the new source of light, reverses its locomotory mechanism. This failure to re-orientate is correlated with the possession of the very long spines characteristic of these larvæ; for when these spines are cut off, the larvæ, on reversal of the direction of the stimulus, re-orientate immediately.

On Loeb's hypothesis the movements which resulted from stimulation by light were 'forced movements', the animal having no choice over its reactions: the predictable result being brought about mechanically. In the sense that *Porcellana* larvæ swim towards the light, the movements seen are 'forced'; but the evidence also shows that these movements are not mechanically produced as Loeb's theory holds, but that there is some nervous integration going on which determines the manner in which the response is to be produced.

Finally, it may be pointed out that to deny the presence of a psychological factor does not materially assist in a better understanding of this interesting form of behaviour.

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June 9.

[1] Loeb, J., "Forced Movements, Tropisms, and Animal Conduct". Philadelphia and London. 1918.
[2] Russell, E. S., "The Behaviour of Animals". London. 1934.
[3] Clarke, G. L., *J. Exp. Biol.*, **9**, 180–211; 1932.
[4] Spooner, G. M., *J. Mar. Biol. Ass.*, N.S., **19**, No. 1, 385–438; 1933.
[5] Foxon, G. E. H., *J. Mar. Biol. Ass.*, N.S., **19**, No. 2, 829–849; 1934.

Alleged Influence of Heavy Water on Mould Growth

LARSON and Barnes[1] suggest that water containing 0·5 per cent of diplogen exerts a stimulating influence on the growth of moulds. The conclusion is based on the results of experiments carried out partly by themselves and partly by S. L. Meyer[2] with *Aspergillus*. Work performed at this Institute casts grave doubt on the validity of their conclusions.

Eight samples of water (diplogen ratio varying from 1 : 8 to 1 : 700) prepared by a method involving contact with paraffin, and ten samples of water (diplogen ratio from the highest concentrations down to 1 : 800) prepared in the complete absence of organic matter, were repeatedly distilled from alkaline permanganate, and were then exposed to diffuse sunlight, in loosely corked test-tubes. All those samples which had been in contact with paraffin showed the growth of moulds; while those samples prepared in the absence of organic matter remained —and in fact still remain—perfectly clear. A sample of water supplied to us direct from the Ohio Chemical and Manufacturing Company was found to possess a faint but unmistakable odour, which could not be removed by distillation from alkaline permanganate, and which suggested the presence of a trace of organic matter, probably of paraffin nature.

It is clear that the water used in the experiments of Larson and Barnes and of Meyer was twice-distilled 'Ohio'-water. We detected moulds in 'Ohio'-water which we 'purified' in the same way; but samples of water of the same diplogen content which we prepared from electrolyte water supplied by Norsk Hydro Elektrisk Kvaelstofaktieselskab remained quite clear.

It is well known that many organic substances, including paraffins, provide favourable nourishment for the growth of moulds. In the light of the observations recorded here, it would appear more reasonable to attribute this growth to the presence of organic impurity rather than to any 'stimulating' effect of the heavy isotope.

The investigations are being continued.

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[1] NATURE, **133**, 873, June 9, 1934.
[2] *Science*, **79**, 210; 1934.

A Modification of the Gas Circulating Pump

OCCASIONALLY, while working with the Blackman-Bolas pump as modified by Leach[1], the apparatus ceases to work owing to the valve on the float side not functioning properly. All pumps, whether prepared in the laboratory or obtained from the manufacturers, behaved similarly, and their action was neither so uniform as one would desire it to be, nor could the rate of flow of air be regulated within sufficiently wide limits.

A circulating pump free from these defects is, therefore, desired. A special type of mercury valve has been devised to replace the float and valve arrangements of the Blackman-Bolas pump, and the pump so modified has been found quite satisfactory. The complete pump with the mercury valve is shown in the accompanying diagram (Fig. 1).

Enough mercury should be put in to reach a little above the tip of the inner narrow tube. This gives

short but rapid oscillations, and a uniform current of air is maintained, the rate of circulation being controlled either by regulating the suction, or varying the amount of mercury.

To ensure regularity of action, a bottle of about 250 c.c. capacity is connected between the circulating pump and the suction pump. The diameter of the lower exit of the valve should be about 2 mm.

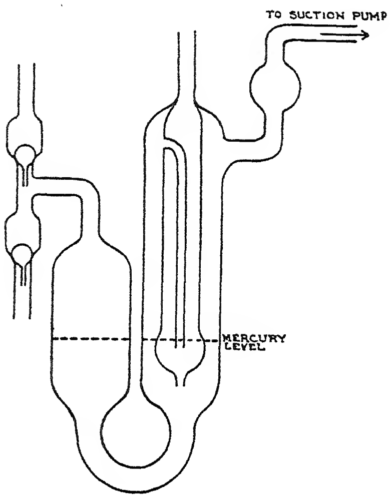

FIG. 1.

This pump has the following advantages: (1) It is one compact unit without any separate parts; (2) it gives a regular current which can be controlled within sufficiently wide limits; (3) once started, it is not liable accidentally to stop working.

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[1] *New Phytologist*, 29, 285; 1930.

Andrew Crosse: Electrical Pioneer

IT is remarkable that the "Encyclopedia Britannica" makes only the merest mention in an article entitled "Electricity" of a man to whom Henry M. Noad dedicated his book "Lectures on Electricity" (George Knight and Sons, Foster Lane, London, 1844) in the following words:

"To Andrew Crosse, Esq., of Broomfield, near Taunton, Somersetshire, to whose indefatigable industry for a long period of years, electrical science is indebted for so rich an accumulation of valuable facts: the interesting results of whose electro-chemical researches have taught us the value of patient enquiry: and whose liberal, open, and communicative spirit is not less remarkable than his enthusiastic love of science."

Much of Crosse's work is outlined in "Memorials of Andrew Crosse" (Longman, Brown, Green, Longmans and Robert, London, 1857) by his widow Cornelia A. H. Crosse. This book also gives a detailed biography, and in it are many of the poems he wrote. On page 54 is a quotation from Singer's "Elements of Electricity and Electro-chemistry" (published in 1814), said to be the first printing of his name in connexion with science. Singer refers to Crosse as "a most active and intelligent electrician", and refers to his electrical exploration of the atmosphere with a copper wire originally a mile and a quarter long, later shortened to about 1,800 feet. With this and its associated apparatus, Crosse demonstrated the presence of positively, and of negatively, charged areas in thunder clouds, and suddenly located in a driving fog a huge 'pocket' of electricity which kept up between the separated terminals an "uninterrupted stream of explosions" lasting "for upwards of five hours".

Among the many things done by this comparatively little-known investigator may be mentioned the following: He treated the poor with his static electric machines "for paralysis and rheumatism, and in almost every case the effect was highly beneficial". He made extensive experiments on the effect of electrical currents on crystallisation and on the growth of plants. In 1816 he predicted "that by means of electrical agency we shall be able to communicate our thoughts instantaneously with the uttermost ends of the earth". He patented the extraction of metals from their ores by electricity, and also the electrical purification of water ("Memorials", p. 218, 221). "I have succeeded in dissolving *largely*, *pure* silver in distilled water, by electric action on a solid mass of it" (p. 237).

"The American Cyclopaedia" (D. Appleton and Co., New York and London, 1874) in an article on Crosse (vol. 5, p. 515) states: "As he worked alone and never published the results of his discoveries, they were unknown to the scientific world until the meeting of the British Association for the Advancement of Science in Bristol in 1836, when he was induced to explain them publicly. The announcement excited unusual interest, and Mr. Crosse was complimented by eminent scientific men."

Born on June 17, 1784, he died on July 6, 1855, in the room where he was born; and he is buried where his ancestors had been laid for more than two centuries. My attention was directed to Crosse and his work by Mr. W. L. Lemcke, of Franklin, Pa., who kindly loaned me the books on Crosse referred to above.

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Coastal Erosion of 'Coral Rock'

IN Lieut.-Col. R. B. Seymour Sewell's interesting article on "The John Murray Expedition to the Arabian Sea"[1], Fig. 1 pictures an undercut coastline of 'coral rock' at Chumbi Island, and this is said to have been "eroded and undercut by wave action".

In some apparently similar coastlines on islands in the Red Sea[2] I concluded that the undercutting was due to a combination of solution of the rock by sea-water and destruction by boring organisms, and certainly not to wave action. It would be of interest to know whether the detailed evidence from Chumbi Island does, or does not, agree with this.

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June 1.

[1] NATURE, 133, 669, May 5, 1934.
[2] *Geogr. J.*, 75, 27–34; 1930.

Research Items

Jaina Temples. Two Jaina temples in the village of Tiruparuttikuṉṟam on the outskirts of Conjeevaram in the Deccan, described and fully illustrated in a monograph by T. N. Ramachandran (*Bull. Madras Government Museum*, N. S., 1, pt. 3), the larger, early Chola with a *maṇḍapa* in Vijayanagara style, the smaller in late Pallava style, supply an epitome of the main features of the chronological development of Dravidian temple architecture. Jainism, which was the most powerful religion in the south from very early times, is held to be the result of a partial attempt to Aryanise the Dravidian races. Conjeevaram has been identified with some certainty as Jina-Kānchī, where a regular colony of Jains seems to have settled early. The larger Jaina temple here studied is the biggest in the taluk, and nowhere else is the style found in so concise and well-balanced a form. The chronological evidence afforded by style is supported by inscriptions, in which the larger temple is peculiarly rich. The ceilings and veranda are adorned with paintings illustrating Jaina mythology. The smaller temple, and the older, is dedicated to Chandraprabha, the eighth tīrthaṅkara, and the larger to Vardhamāna, the twenty-fourth tīrthaṅkara. Local tradition says that the two owe their existence to a Pallava king and that he built them at the instance of two Jaina teachers, who lived in the village. While the first part of the tradition is in accordance with the style of architecture, the latter part is evidently incorrect, as an inscription in the temple shows that the two teachers were not contemporaneous with the Pallavas, but flourished six centuries after them, that is, in the fourteenth century.

Animal Worship in Bengal. An account of an animal shrine and worship at Uttarbhag, Lower Bengal, by Dr. Sunder Lal Hora has recently been published (*J. and Proc. Asiatic Soc. Bengal*, N.S., 29, No. 1). This desolate part of the Sundarbuns, dense jungle and infested with wild animals, is visited annually in October and May by a large number of people for wood-cutting and fishing. They practise a great variety of religious rites to propitiate the deities of jungle terror of all sorts. Uttarbhag is a small trading village, 23 miles to the south of Calcutta. In the month of February it was noted that some kind of *pūjā* had been practised at three different places in the village. The most conspicuous evidence of the ritual was a mud platform, on which were four images representing *Manasā*, the serpent goddess, *Makar*, the crocodile, *Dakshindar* or *Bŏn Bībī* and *Pānch-pīr*. Inquiry elicited the fact that the people had no conception of the godlings they worshipped. They referred the inquirer to the Brahmin who had performed the ceremony. The *pūjā* is performed jointly by Mohammedans and Hindus. The services of a Hindu priest are required for the worship of *Manasā* and *Makar* and of a Mohammedan, usually a *faqīr*, for that of the remaining two. The *faqīr* is said to have the power of driving away the harmful beasts of the jungle. It is significant that at Uttarbhag these five deities are worshipped at a single festival in January–February, instead of separately on the day of the year appropriate to each. In Bengal the worship of *Manasā* occupies a prominent place. At Uttarbhag she was represented by two conical mounds of mud, each mound having three clay heads of cobra arranged on one side and a mark in vermillion on the front. The crocodile was represented by a mud model. Of the four images of *Dakshindar*, two were said to represent the wife of Dakṣin Rāy. This wife is an innovation. The *Pānch Pīr*, 'Five Saints', were five balls of earth placed on a mud platform. Their names were unknown to the people.

Races of the Chimpanzee. Variation in the hair coat, affecting both distribution and colour, and in the colour of the skin, have led to the creation of unwarrantable specific names for chimpanzees. Ernst Schwarz considers that all the varieties represent no more than four local races of one species, variously known as *Pan satyrus* or *Anthropopithecus troglodytes*. Of these racial forms, the typical *satyrus* is confined to the French Congo, *verus* to the forested parts of Upper Guinea from the Niger as far west as the Gambia, *schweinfurthi* to the forests of Central Africa, north and east of the Congo, and the distribution of *paniscus* is not stated, on the ground that it was adequately described in 1931 (*Ann. Mag. Nat. Hist.*, June 1934, p. 576).

Evolution of the Hermit Crab. Prof. Charles Pérez has recently gathered together, in a short survey, the scattered information on the general biology of the commoner species of hermit crabs; and by indicating the adaptations of type species arranges the Paguridea into an evolutionary sequence ("Les Pagures ou Bernards L'Ermite: un exemple d'adaptation". *Actualités Scientifiques et Industrielles*, **101**; 1934). According to Prof. Pérez, the Decapoda in general show development from a primitive lobster-form to a more highly evolved crab-type. He suggests that though there is a lack of geological evidence, existing forms of Paguridea may be taken as indicating a line of evolution in the Decapoda which has gone through the hermit crab stage to arrive finally at the more advanced crab-type; and has carried with it, in the structure of the adult and to a certain degree in the life-history of the individual, evidence of the route which it has taken. To the non-specialist, interested in natural history subjects, this paper should prove both interesting and instructive; the serious zoologist already will be familiar with most of its contents.

Habits of the Corn-Bunting. In North Cornwall, where Lieut.-Col. and Mrs. B. H. Ryves have studied the corn-bunting (*Emberiza calandra*) intensively for two years, the species is undoubtedly double-brooded, although many hens are content with raising only one brood in the course of a season (*British Birds*, June 1934, p. 2). Three broods are probably a very rare occurrence. Such restricted breeding may be associated with the extent of the duties carried out by the female, for she alone is concerned in the building of the nest and in the incubating of the eggs, and almost alone she undertakes the rearing of the young, which on rare occasions may be fed by the male parent. Perhaps the devolution of work upon the female has encouraged also the habit of polygamy; the twenty-four males observed during the season of 1933 had between them forty-five hens, and a total number of fifty-four nests, from which at least 126 young were safely reared. The nests of a breeding

group were sometimes close together, sometimes separated by distances up to 60 yards, but neither within the groups nor between the groups were there shown signs of territorial jealousy, although territories were well defined. In the first week of August, song diminishes in quantity, by mid-August the birds are silent, and by the end of August breeding territories are deserted.

Vegetative Propagation of Cacao. The third annual report on cacao research, 1933, published by the Government Printer, Trinidad, 1934, shows the botanical section of the Imperial College of Tropical Agriculture making progress with the problem of propagating this plant vegetatively. Extensive survey work is gradually achieving the first object, the location of a thousand trees suitable for more intensive study. Some 750 of these trees have been located and progress made with the next stage, of reducing their number to 100 suitable for more careful record of yield. These are then to be gradually reduced in number by careful field studies until types suitable for propagation as clones are available. In the meantime, experience is being gained of the technique of propagation, and fair results obtained by the use of cuttings in fine sand. One point of interest reported upon by Mr. E. E. Pyke is the branch habit of the plant in relation to propagation. The original seedling stem has a 3/8 phyllotaxis and a radial habit, but most branches have two ranked leaves and a plagiotropic habit. Obviously the first type has advantages for cutting propagation, and so it is desirable to study methods of stimulating the production of erect branches with radial habit. Cutting back the branch system, coupled with ring-barking, has proved very successful. It might be worth while, as in the case of apple stocks, to try the effect of cutting back coupled with earthing over the base of the branch shoots to stimulate root production before they are removed from the parent plant as isolated cuttings.

Gilled Fungi of Victoria. An article by Mr. J. H. Willis on "The Agaricaceæ or Gilled Fungi; Some Species common in Victoria" appears in the *Victorian Naturalist* (**50**, No. 18, 264, April 1934). Field study of the Agaricaceæ is in its infancy in Australia, but the paper under review provides a very useful introduction to the would-be student of outdoor mycology. A key for the determination of about seventy of the commoner species is given, and descriptions of each species appear. It is interesting to note that most of the species are such as are found in England, and the list would be a guide to our most common species here. The account is enriched with two coloured plates and numerous text figures. A very interesting fungus is "Blackfellow's Bread" (*Polyporus mylittæ*) which produces a large, dark sclerotium just below the surface of the soil. *Cordyceps Gunnii* and *C. gracilis*, two Ascomycetes, are also described, the former producing ascospores in threads emerging from the perithecia.

Plant Diseases in the Philippines. Trinidad Valley and the environs of Baguio are districts in the Philippine Islands where vegetable crops are grown intensively. Seeds and plants have been imported from other countries, and a considerable number of diseases have also made their appearance. These have been studied by Dr. T. G. Fajardo, who has published the results of his survey (*Phil. J. Sci.*, **53**, No. 1, 67, Jan. 1934). Diseases of the cabbage and other cruciferous crops, cucumber, chayote, pea, bean, egg-plant, pepper, potato, tomato, celery and other plants are described, and symptoms of several maladies are shown upon twenty-five excellent plates. Many of the diseases are well known in the British Isles—black rot of cabbage (*Phytomonas campestris*), bean rust (*Uromyces appendiculatus*), potato blight (*Phytophthora infestans*), potato scab (*Actinomyces scabies*) and several virus diseases. No specific methods for the control of each disease are given, but general methods of plant hygiene, spraying and the use of resistant varieties are set forth at the end of the paper.

Lower Cambrian Archæocyathinæ of South Australia. The Archæocyathinæ of South Australia were investigated very thoroughly by T. Griffith Taylor (1910). His work has now been supplemented by R. and W. R. Bedford in a paper on "New Species of Archæocyathinæ from the Lower Cambrian of Beltana" (*Mem. Kyancutta Mus.*, No. 1, pp. 1–7, pls. i–vi, 1934). These authors have obtained new material from the Ajax Mine in the Flinders Range, from which they describe and illustrate 32 new species and 8 new genera. Notwithstanding the excellent state of preservation of the Australian Archæocyathinæ, their systematic position is still a matter of uncertainty, and the present authors refrain from discussing this interesting question. These organisms have been variously referred to algæ, sponges, corals, or an independent group allied to Cœlenterates. Taylor was inclined to regard them as related to calcareous sponges, although some of their structures at any rate simulate those found in corals. A new genus, *Acanthocyathus*, may lend support to this view since it is claimed that the outer wall is formed of spicules. The Archæocyathinæ seem to have had a world-wide distribution in Cambrian times. Recently a considerable number of new forms have been described from Siberia by Wologidin.

Crustal Movements in South Africa. Evidence of recent rising in the coastal zones and warping of the interior of South Africa are discussed by Dr. A. L. du Toit in the *South African Geographical Journal* of December 1933. He points particularly to the eastern plain of Mozambique and the south and south-west coasts of the Cape Province. This uplift which affected the whole of South Africa was differential, and thus there were caused areas of depression or basins separated by ridges or axes of uplift. Such depressed areas are the Karroo-Basutoland, the Bushveld, Limpopo, Ngami, Ovampoland, Zambesi and other depressions. These have involved vertical movements of several thousand feet in places. The axes of the uplift and the longer axes of the depressions lie south-west and north-east or east-north-east, which suggests that they all owe their origin to the same tectonic causes. Dr. du Toit believes that these features mark a southerly expansion of the Central African rift system. The volcanic activity characteristic of the rift system is absent from the south, but occasional earthquake shocks are experienced there. It is suggested that there is evidence that these tectonic movements have persisted into the human period.

Fine Structure of Valve Characteristics. B. van der Pol and Th. J. Weijers have made an important investigation of the detailed structure of diode,

triode and tetrode characteristics (*Physica*, 1, No. 6, 481, April 1934). The experimental method consists in impressing a sinusoidal voltage on the steady grid potential and separating and measuring the harmonics in the anode current. It is shown that the amplitudes of the successive harmonics are, in general, proportional to the various differentials of the characteristic curve. (This is, however, not true at points of discontinuity.) The results show that the differential curves often indicate a large number of maxima and minima. They reveal that certain points on the characteristics may show a marked absence of detecting properties. In addition to this result of technical importance, the authors consider that their method may be of use in investigating such physical points as the critical potentials in secondary electron emission. They also discuss the use of the functions called Tchebycheff polynomials in the representation of valve characteristics.

Numerical Solution of Differential Equations. D. R. Hartree (*Mem. Manchester Lit. and Phil. Soc.*, **77**) has given a detailed description of a method of solving the differential equation :

$$\frac{d^2y}{dx^2} = f(x, y)$$

by numerical methods. This equation arises in Hartree's method of calculating self-consistent atomic fields, but it occurs very frequently in other branches of physics. The method given is applicable to equations involving functions specified by tables, in the absence of an analytical form. It is claimed that it is rapid and easy to apply. The method is self-checking, so that computing errors are apparent before they are deeply involved in subsequent work.

A Photoelectric Illumination Meter. Much interest has recently been taken in the new direct-reading photometers based on the use of photoelectric cells. The latest instruments of this type comprise only two essential parts, a photoelectric cell and a moving coil indicator. The cell is exposed to the illumination to be tested, the movement of the pointer being proportional to the intensity of the light. Photoelectric cells of the alkaline metal type have the drawback that a battery of constant E.M.F. is needed ; also the electrical output is so small that a highly sensitive instrument is necessary. The metal oxide type of cell, on the other hand, does not need a polarising battery, and the output is much greater. Thus a single selenium oxide cell suffices to operate a relatively robust instrument. In one recent type of apparatus, the Salford foot-candle meter, a cell $1\frac{3}{8}$ in. in diameter, is mounted in the hinged lid of the box containing the measuring instrument, the scale of which is graduated in foot-candles (50 ft.-c. giving the full-scale deflection). It is claimed that with such a photometer, most artificial lighting installations can be measured with sufficient accuracy. Under reasonable conditions, in the measurement of light from incandescent (filament) electric lamps, an accuracy of 2 per cent is stated to be possible. Fatigue is, however, set up by over-exposure of the cell to very bright light, and there is some degree of colour-error in the case of systems departing very widely from the normal daylight spectrum. Errors up to 30 per cent may, for example, be experienced with gaseous discharge lamps. A correction may be applied to obviate this difficulty which, however, does not arise in comparative measurements with the same type of source of light.

Interstellar Matter. The presence in interstellar space of widespread light-scattering material is now fairly generally accepted as the explanation of the well-known 'reddening effect' in the more distant stars. The question of the distribution of this light-scattering material is discussed by E. G. Williams in the *Astrophysical Journal*, vol. 79, p. 280. The diffuse matter giving rise to the 'stationary lines' of calcium has already been shown to be approximately uniformly distributed, and a comparison of the intensities of these interstellar lines with the colour excesses of stars is a useful method of judging the uniformity of the former (light-scattering) material. The author has measured the intensities of the interstellar [*K*] line in the spectra of 67 stars. The spectrophotometric method is described, and total absorptions are obtained with probable errors of about 5 per cent. These are compared with colour excesses obtained from three sources, which have been corrected on account of absorption by the Balmer lines of hydrogen. A statistical correlation is found between colour excess and interstellar [*K*] intensity, but the considerable dispersion indicates that the scattering matter is not co-extensive with the calcium. The bright-line stars form a group to themselves, and are all too red for their distances. This may have some bearing on Struve's theory of their origin, in which the extra reddening effect would be caused by an atmosphere of scattering matter ejected from rapidly rotating stars.

The Gas from Indian Oil Wells. Under the auspices of the Geological Survey of India in co-operation with leading oil companies, some interesting investigations of the oil-gas of Burma and Assam have recently been carried out. The results of these investigations are recorded in a paper by G. P. Kane, K. R. Krishnaswami and H. E. Watson (*J. Indian Inst. Sci.*, 17A, Part 3 ; 1934). The primary object of the undertaking was to assess the helium content of these gases, but complete analyses comprising carbon dioxide, carbon monoxide, oxygen, nitrogen, hydrogen, methane and propane contents were also effected. Throughout the investigations, special precautions were taken owing to the high methane content of the gases. This constituent is appreciably absorbed by alkaline pyrogallol, bromine and ammoniacal cuprous chloride, while with the higher hydrocarbons the tendency is even stronger. For this reason, the gases were submitted to fractionation before analysis. Tabulated results indicate quantities obtained by fractionation, amounts of the different gases present in each sample expressed as percentages on the dry gas, and helium content in parts per 100,000. Scrutiny of this table shows that the five samples from Burma were somewhat similar in composition, with the exception of one which had an abnormally high nitrogen content. One of the seven samples from Assam resembled the Burmese gases except for its high carbon dioxide content ; two were remarkable for their high nitrogen content and four for their low ratio of methane to other hydrocarbons. A natural gas from a seepage at Gogha, Bombay, was practically pure methane mixed with air. In all cases the amounts of helium determined were of the same order as in air, and in no case was the quantity sufficient for commercial extraction.

International Congress on Theoretical Physics at Kharkov

AN International Congress on Theoretical Physics was held at Kharkov on May 19–23 under the auspices of the Ukraine Physico-Technical Institute, and the chairmanship of L. Landau. At the official opening of the Congress, Prof. Niels Bohr, of Copenhagen, delivered a lecture on "Causality in Physics". Papers were read by E. J. Williams, E. Lifschitz, M. S. Plesset, V. A. Fock, L. Landau, I. Waller, J. Frenkel, M. Bronstein, J. Solomon, I. Tamm and L. Rosenfeld; and Niels Bohr joined in the discussions.

Williams described the general state of research on the scattering of hard γ-rays, and his recent experiments with thin scatterers. If sufficiently thin scatterers are used, the range of the electrons produced by the γ-rays is sufficient to enable them to escape from the foil and therefore to avoid annihilation except far away from the foil. In this way the annihilation radiation is separated from the other part of the radiation. It is found by this method that the annihilation radiation definitely exists and constitutes the whole of the scattered radiation of $0{\cdot}5 \times 10^6$ volts. From observations on the variation of the scattered intensity with the thickness of scatterer, an approximate estimate of the energy of the positive electrons may be made. The fraction of low energy positive electrons proves to be unexpectedly high, and may be explained by the production of double pairs. In the discussion, Frenkel suggested that the low energy of some positive electrons might be due to the production of pairs by a Compton effect. Gray and Tarrant's result that the energy of scattered radiation is practically equal to that of the absorbed incident radiation could be explained in the same way. Williams described a method of obtaining Heitler and Sauter's formula for the energy lost by an electron in radiative collisions with a nucleus. The perturbing field of the nucleus is analysed into harmonic components and the Klein-Nishina formula is applied to the scattering of the separate components.

In another paper, Williams described some evidence for the existence of the negatron, provided by observations of Kunze on cosmic rays. Kunze's Wilson chamber photographs seem to show that the high energy particles of cosmic radiation produce about 20 ions per cm. in normal air. If the particles were electrons, about thirty-five would be expected; if they were protons, twenty to twenty-five. As some of Kunze's tracks have a negative curvature, they may be due to negatrons.

Plesset discussed Dirac's theory of the positive electron and the developments made by Fock and by Carlson and Oppenheimer. The difficulties in these formulations connected with invariance was pointed out. Dirac's recent procedure is the only one so far which possesses the required invariant properties, but it is only approximate. The significance of the approximation was explained.

In another paper, Plesset described an application of quantum electrodynamics to the determination of the proper energy of a vacuum with the theory of filled negative energy states. Transitions are considered from the initial state of the vacuum distribution to intermediate states in which an electron-positron pair and a quantum of radiation are present; then transitions are considered from these intermediate states back to the initial state. The intermediate states may be given the picturesque interpretation of representing fluctuations in the vacuum distribution. If the summation over all intermediate states is performed, an expression is secured which represents the coupling of the initial state with itself by means of an effective self-interaction energy. This proper energy of the vacuum may be readily found to be infinite. An analogous calculation may be made for the case of the presence of an external field.

Lifschitz discussed the production of electronic pairs by a collision of two particles. The cross-section is calculated when the velocities are near to the velocity of light. For this case the particles may be assumed as moving rectilinearly without interaction and the effect is then due merely to the superposition of both fields. The calculation shows that the whole cross-section increases with the cube of the logarithm of the energy of the colliding particles.

Waller discussed the recoil of rays scattered by free electrons. It is well known that the theories based on point electrons do not make possible an adequate treatment of this problem. The appearance of infinities in the problem of the recoil of rays from bound electrons has been avoided by special devices (Dirac, Landau, Weisskopf, Wigner and others). In this way, analogies with classical theory have been obtained. The appearance of infinities in the problem of scattering by free electrons may be avoided in the calculation of the recoil (to the first approximation) by a simple device based on Dirac's theory of rays.

Fock described his mathematical developments of Dirac's theory of the positive electron. This work was published in Russia in 1933 and has not yet become sufficiently known. He explained that it simplifies the mathematics, but does not alter any of the physical difficulties in the theory; it has only made them more accessible.

Tamm discussed the deduction of exchange forces between neutrons and protons from Fermi's theory of β-radioactivity based on the assumption that transmutations of a neutron into a proton and vice versa are possible, and are accompanied by the birth or disappearance of an electron and a neutrino. Consider two heavy particles, a and b, a being in a neutron and b in a proton state. If a becomes a proton and b a neutron, the energy remains unchanged. Now those two degenerate states of the system may be linked by a two-step process—the emission of an electron and a neutrino by the neutron (a), becoming a proton, and the ensuing reabsorption of these light particles by the proton (b), becoming a neutron. The energy of the system is in general not concerned in the intermediate state. The emission and reabsorption of a positron and neutrino may also take place. In this way the two degenerate states of the system considered are split into two energy states differing by the sign of the exchange energy. Calculation shows that if the difference of masses of the neutron and of the proton is larger than the sum of the masses of an electron and a neutrino, the emission of light particles by a heavy particle may take place without a violation of the conservation of energy. But the corresponding value of the exchange energy may be shown to be far too

small. The negative result indicates that either the Fermi theory needs a substantial modification or that the origin of the forces between neutrons and protons does not lie, as would correspond to the original suggestion of Heisenberg, in their transmutations considered in detail by Fermi.

Rosenfeld described researches made in collaboration with Cambresier on dissociative equilibrium in stellar atmospheres. The number of molecules of a given kind in the atmosphere of a star can be calculated as a function of the effective temperature and surface gravity of the star on the assumption of dissociative equilibrium. In this computation it is essential to take into account the variation of pressure in the different layers of the atmosphere. The pressure at the base of the atmosphere may be calculated from the general absorption, by a method first used by Milne and Chandrasekhar. The treatment of concrete cases necessitates assumptions on the relative abundances of the atoms taking part in the reactions, but the results are quite insensitive to such assumptions. The equilibria of TiO, ZrO, and of the carbon combinations CN, CH, CO, C_2, have been computed in two different cases: when O is much more abundant than C, and vice versa. It is seen that the first case corresponds to the main sequence, the second to the branch of carbon stars, and that simply on this assumption a satisfactory agreement is obtained with the observed variations of intensity of the corresponding bands with spectral type and surface gravity (giant or dwarf character of the stars).

The members of the Congress had the opportunity of visiting many interesting institutions in Kharkov, Moscow and Leningrad. The laboratories of the Ukraine Physico-Technical Institute, and the Physical Institutes in Leningrad and Moscow were attractive, on account of the youthful enthusiasm of the staffs, besides the variety of the researches in progress. The Dzerzhinsky School for Orphans at Kharkov, organised and supported by personal subscriptions from the members of the G.P.U., contains four hundred boys and girls. They live with a large degree of self-government, and are trained in three magnificent factory-workshops, one of which is for the complete manufacture of cameras on the Leica model, including the lenses. A *kolkhoz* of three thousand acres supporting seven hundred persons was also very instructive. At the Kharkov Tractor Works, tractors of the McCormick type could be seen running off the assembling conveyor at the rate of 140 per day. In Moscow the constructive works of the underground railway were prominent. The members of the Congress will remember for a long time the interest of their visit and the hospitality of their hosts.

Aberdeen Meeting of the British Association

IN a previous article (NATURE, 133, 673, May 5), reference was made to the suitability of Aberdeen as a centre for excursions, and advantage has been taken of the city's position in this respect by the local committee for the Aberdeen meeting of the British Association to be held on September 5–12. Arrangements for excursions to places of historical interest through some of the most striking natural scenery in Scotland have now been completed. The Committee did not dare to hope that it could call upon the members of the Association to repeat the experience of its predecessors of nearly eighty years ago, where some of the excursions occupied the better part of two days. It has therefore arranged that the excursions taking place on the Saturday of the meeting will start at a comfortable time after breakfast and arrive back before dinner. The Committee has been fortunate in securing the services of authorities on the different areas and places of interest to be visited to write descriptive articles on the general excursions, and these articles will add to the enjoyment of these excursions. Arrangements have also been made for guides where necessary to accompany the members and to give information concerning the different places visited.

Probably the most interesting excursion for those who enjoy natural scenery is the Highland excursion. This starts at 9.20 a.m. by train through the cultivated parts of Aberdeenshire and Banffshire, thence into the valley of the Spey, which is followed, first westwards to Boat of Garten, then southwards to Aviemore where, looking eastward, there is a striking view of the Cairngorm range of mountains. Visitors should notice a V-shaped depression between Ben MacDhui and Braeriach, which marks the position of the highest mountain pass in Scotland—Lari Gghru. After leaving Aviemore, the train proceeds towards Inverness, passing Carr Bridge and Tomatin to Culloden Moor, where the members will leave the train and proceed by bus to the battlefield. There, local guides will join the party and give a short account of the battle and the objects of interest, including the famous Clava Cairns, on the Moor. The visitors will then proceed to Inverness, alighting on the Castle Hill. In Inverness they will be entertained by the Provost, Magistrates and Town Council to tea. After an interval, which can be utilised for seeing some of the places of interest in the city, the train will return from Inverness by the coast, from which there is a striking view of the mountains of Ross-shire, Sutherland and Caithness, the most prominent among these being probably the cone of Morven, which can be seen for a long way along the coast.

From a historical point of view, an interesting excursion is that which has been arranged to leave Aberdeen at 9.40 a.m. by train to Elgin, arriving there at noon. There, the members of the Association will be welcomed by the Lord Provost, Magistrates and Town Council of Elgin, and will be entertained to lunch. After lunch they will proceed by charabanc through the ancient province of Moray, which abounds in historical remains. The itinerary will be from Elgin Cathedral to Spynie Castle, Lossiemouth, Duffus Castle, Kinloss Abbey and Pluscarden Abbey. There will be an interval at Pluscarden Abbey, where tea will be provided near the ruins. Thereafter the party will return to Elgin, whence they will entrain for Aberdeen at 5.15 p.m., returning by a different route.

An excursion has also been arranged by motorbus leaving Marischal College at 10 a.m., and proceeding along the North Deeside Road through the Pass of Ballater and Braemar to the Linn of Dee. On the return journey from the Linn of Dee, a halt will be made at Braemar for lunch. The party will

then return to Ballater, halting en route to view Crathie Church, then along the South Deeside Road through Pannanich and Glentanar, there being an interval for tea at some appropriate place.

Another charabanc excursion has been arranged which will take members of the Association partly along the Cairn O'Mount Road—the old main road from north to south. The starting time will be 10 a.m. from Marischal College, and from there the route lies along the south side of the Dee, thence along the valley of the Feugh to the Glen of Dye, over the Cairn O'Mount to Fettercairn and Edzell, where a halt will be made for lunch. On the return journey the route passes through Brechin and Stonehaven. Many places of historical and archæological interest are passed through on the way.

In addition to these all-day excursions, two half-day excursions have been arranged for the Saturday. The first of these leaves Marischal College at 1 p.m. by motor bus and proceeds by Castle Fraser and Monymusk, through 'Lord's Throat' to Alford, thence by Muir of Fowlis and Crossroads, Lumphanan to Tillylodge and Tarland. This excursion will return to Aberdeen about 7 p.m. The second of these excursions will leave Marischal College at 1.30 p.m. by charabanc. The itinerary is by way of Stonehaven, over the Slug Road to Banchory, on Deeside, thence to Potarch and Torphins, returning to Aberdeen at 6 p.m. This excursion is somewhat similar in interest to the preceding one.

Excursions have also been arranged by several sectional secretaries of the Association. These include visits to places of historical, archæological and geological interest, also visits to places typifying the various industries and activities of the area.

The meeting of the Association in Aberdeen has also provided an opportunity for commemorating the work of Prof. John Lamont, the Scottish astronomer and pioneer of modern terrestrial magnetism, who was born at Braemar in 1805 and was for many years director of the Royal Observatory of Munich, where he died in 1879. A sum of money has been raised to provide a monument which will be placed at Inverey near to his birthplace, and it has been arranged that the monument will be unveiled on the afternoon of Monday, September 10. A motor-bus will leave Marischal College on that date at 1.30 p.m., and will convey members of the Association who desire to be present at the unveiling of the memorial, which has been fixed for 4 p.m. approximately.

The Local Committee is confident that the members of the Association will show their appreciation of the arrangements made by taking full advantage of the opportunities offered.

William Froude and Experimental Tanks

THE summer meeting of the Institution of Naval Architects, which was held in London on June 10–13, was made the occasion of an International Conference on Experimental Tank Work. It was attended by delegates associated with experimental tanks in Great Britain and in Austria, France, Germany, Holland, Italy, Japan, Norway, Spain and the United States, and was notable for the many tributes paid to the work of William Froude (1810–1879) who may well be called the 'father' of the experimental tanks.

The proceedings were opened on June 10 in the hall of the Royal Society of Arts with an address by Lord Stonehaven, the president of the Institution, who said that many men of many nationalities have helped to elucidate those intriguing and often baffling problems which confront and sometimes perplex the ship designer, but there is one name which stands out above all others—that of the late William Froude, originator and pioneer of the experimental tank method of research.

Lord Stonehaven gave, in chronological order, a list of the principal tanks in the world and at the conclusion presented to the representatives of the tanks copies of Froude's portrait in bronze plaques which had been prepared for the occasion. Three papers were afterwards read, the first of these being by Sir Westcott Abell on "William Froude", while the second and third were respectively by General G. Rota of the Rome National Tank and Prof. T. B. Abell of the University of Liverpool.

Afterwards, during the proceedings, other papers were read, and there were a Government reception at Lancaster House, a dinner at Grosvenor House and various visits and excursions, including an inspection of the William Froude Laboratory at the National Physical Laboratory.

Froude's first model experiments were made in a large storage tank at the top of his house at Paignton, where he had gone to live in 1859. He removed to a new house, "Chelston Cross", at Cockington, Torquay, in 1867. Through the suggestion of Sir Edward Reed, the Admiralty agreed to pay for the construction of a tank according to Froude's design, and thus came into existence the pioneer Torquay tank, 278 ft. long, opened in 1874.

Nine years later, William Denny at Dumbarton built the first privately owned tank, and in 1886 the Admiralty built the naval tank at Haslar which was placed under the charge of Froude, who at his death was succeeded by his son R. E. Froude. The other tanks in Great Britain now are those of Messrs. John Brown and Co., Ltd., at Clydebank and Messrs. Vickers-Armstrong, Ltd., at St. Albans and the Yarrow tank, opened in 1911, and the new Government tank, 680 ft. long, both at Teddington. Of the last-named, opened by Mr. Baldwin in 1932, an account was given in NATURE of November 26, 1932, p. 800.

Of the tanks in foreign countries that at Spezia was opened in 1889, and that at Washington in 1898. These have been followed by others at Bremenhaven 1900, Charlottenberg 1902, Paris 1905, Hamburg 1908, Nagasaki 1908, Tokyo 1910, Vienna 1919, Rome 1929, and the tank at Wageningen, Holland 1933. The Nagasaki tank was destroyed in the earthquake of 1923, while the Hamburg tank is now one of a group of five belonging to the Hamburg Model Experimental Establishment. The tanks all differ in their dimensions, and their equipment includes all the refinements rendered possible by the advance of science; but the fundamental methods employed are based on those of Froude's. Tests are carried out on models of battleships, destroyers, liners, tramps and even fishing craft and dumb barges, and each tank is a centre of research.

Biochemistry and the Manufacture of Fine Chemicals

IN the Jubilee Memorial Lecture, 1933–1934, of the Society of Chemical Industry, delivered under the above title, Dr. F. H. Carr dealt chiefly with recent progress in the field of hormones and vitamins. In referring to the ill-defined boundary between biochemistry and organic chemistry, he classed as biochemical "those substances that exert dynamic properties in connexion with living processes and are directly concerned with chemical changes underlying physiological function". He characterised the technical production of insulin from the pancreas as one of the most important applications of biochemistry to the fine chemical industry, since countless human beings are kept alive by the use of this product. Insulin is a protein-like body of high molecular weight and unknown constitution, which enables the animal organism to deal with glucose; the total amount required daily by the human subject is about 5 mg. Only about 1 mg. per diem of thyreoglobulin, which occurs in the thyroid gland, is needed to promote the primary oxidative changes in the body. This complex protein owes its physiological properties to an iodine-containing derivative, thyroxine. The constitution of this substance is known, and it may be produced commercially at a cost lower than that of natural thyroxine. Adrenaline, another active hormone, which produces "all the vascular and visceral reactions accompanying the emotions of danger, excitement, and fright", has also been synthesised and subjected to successful large-scale manufacture.

Vitamin D (calciferol), of which about 0·05 mg. is required daily to promote the absorption of calcium and phosphate from the intestine into the blood, is formed when ultra-violet rays act upon ergosterol: "the pure vitamin can now be made and sold at such a price that our daily requirements cost less than one-tenth of a penny. Purchased as pure crystals, vitamin D now costs one-eighth its price in cod-liver oil". Vitamins A and D are fat-soluble substances found in the unsaponifiable fraction of certain fats. The recently synthesised vitamin C (ascorbic acid) is of a different type. It has been assigned the constitution 3-keto-*l*-gulonolactone, and is thus a remarkably simple substance having the formula $C_6H_8O_6$. It is the first vitamin to be completely synthesised by the methods of organic chemistry.

Dr. Carr remarks that there was something of a mystical element in Szent-Györgyi's discovery of ascorbic acid. Having isolated it from adrenal glands, he overcame great difficulties in obtaining it from various plant materials: thus, in 1928, from 5,000 oranges he was successful in preparing only a very minute quantity. One evening in 1932, at Szeged, his wife gave him pepper for supper. This was the big red Hungarian capsicum. He could not eat it, but was impelled with his whole household to extract vitamin C from it—"with the result that after three weeks of hard labour we had a full pound of the pure crystalline ascorbic acid". This sudden production in large quantity of a substance previously only seen in microscopic amount led directly to the final elucidation of its constitution and its synthesis.

Some Tunicates of the *Terra Nova* Expedition*

THE first portion of Prof. Garstang's long-promised account of the tunicates of the *Terra Nova* Expedition is now issued. This includes the Doliolida only, for each group is to be dealt with separately. It is not only a list and description of the species found, but also a critical monograph on the subject, containing valuable new views and a detailed survey of the work of previous writers, the whole being a helpful and important contribution to our knowledge of those pelagic tunicates which reproduce by budding and have 'nurse' stages.

No really new species are added but certain alterations in existing forms are made—one variety is raised to a species, a new genus is proposed, subgenera are raised to genera and the status of several species is reduced; the classification being completely revised. Every specimen has been examined, measured and recorded and the details summarised for each station separately. In the new classification proposed, the form and relations of the alimentary canal in gonozoid and phorozoid are taken as diagnostic; also prominent features in the diagnosis of most species are the myomeristic growth-limits set up by the muscular rings, which are shown to act as obstacles to the forward extension of the branchial septum and testis during the late stages of growth. These limits depend on the period of meroblastic adhesions between inner and outer membranes, which may be accelerated or retarded by outside conditions such as temperature and food supply. Thus it is thought that many pairs of so-called species are in reality no more than environmental modifications.

In the chief work, which has been a study of the variation of certain characters in the common species and an attempt to discriminate between different kinds of 'old nurse', the measurements of the muscle-bands have proved very useful, especially in the latter. A very interesting fact is the distinction to be found in the otolith which usually drops away after death in the 'old nurses' of two species of *Doliolina*, but rarely in the third.

It is taken for granted that the ancestors of the Thaliacea were sessile primitive ascidians with a tailed larva and a metamorphic life-history, and that, of existing Thaliacea, the doliolids constitute the group most highly adapted to an active pelagic existence. The evidence in support of this view has been clearly set out in the author's earlier papers.

The specimens from the *Terra Nova* Expedition come from four different areas—Atlantic, Pacific, Southern Ocean and McMurdo Sound. Three genera are recognised (the fourth *Dolioloides* in the present classification not being represented). These are *Doliolina*, *Dolioletta* and *Doliolum*, two species in the first, two in the second and one in the third. The single species from the antarctic region proper, the *D. resistabile* of Neumann, here called *Doliolum intermedium* var. *resistabile*, was actually taken within the antarctic circle, further south than any doliolid so far recorded.

* Report on the Tunicata. Part I. Doliolida. By Prof. Walter Garstang. British Antarctic (*Terra Nova*) Expedition, 1910. Natural History Report. Zoology. Vol. 4. No. 6. 1933. British Museum (Natural History).

University and Educational Intelligence

LEEDS.—Mr. E. R. Flint has been elected to the chair of clinical surgery in succession to the late Prof. Alfred Richardson. Mr. Flint will also retain the directorship of surgical research which he has held during recent months. Mr. H. W. Thompson has been appointed advisory entomologist on the staff of the Department of Agriculture. Mr. Thompson is at present on the advisory staff of University College, Cardiff.

LIVERPOOL.—At the meeting of Council on July 10 it was agreed to accept with regret the resignation of Prof. L. R. Wilberforce from the Lyon Jones chair of physics in the University, to take effect not later than September 30, 1935.

The following appointments have been made: Dr. A. M. Blackman, to the Brunner chair of Egyptology as from October 1, in succession to the late Prof. T. Eric Peet; Prof. D. B. Blacklock, Walter Myers professor of parasitology in the University since 1929 and formerly professor of tropical diseases of Africa, and director of the Sir Alfred Lewis Jones Research Laboratory, Sierra Leone, to the newly instituted chair of tropical hygiene as from October 1; Dr. T. Southwell, lecturer in helminthology in the Liverpool School of Tropical Medicine, to be lecturer in parasitology as from October 1.

The main University library is at present housed in the Tate Library, the gift of Sir Henry Tate in 1892. This present accommodation is altogether inadequate in view of the great increase in the library and the number of readers. Mr. Harold L. Cohen, of Liverpool, has therefore made a gift of £100,000 to the University for the erection of a new library. It is intended to erect the new library on the site of the old School of Architecture in Ashton Street.

LONDON.—The following appointments have been made:—Prof. H. E. Watson, professor of general chemistry at the Indian Institute of Science, to be Ramsay Memorial professor of chemical engineering (University College); Dr. A. B. Appleton, lecturer in anatomy in the University of Cambridge, to be professor of anatomy (St. Thomas's Hospital Medical School); Dr. S. P. Bedson, senior Freedom research fellow at the London Hospital, to be the Goldsmiths' Company's professor of bacteriology (London Hospital Medical School); Prof. F. R. Fraser, University professor of medicine at St. Bartholomew's Hospital Medical College, to be professor of medicine (British Postgraduate Medical School); Dr. James Young, lecturer in clinical obstetrics and gynæcology in the University of Edinburgh, to be professor of obstetrics and gynæcology (British Postgraduate Medical School); Prof. E. H. Kettle, since 1927 University professor of pathology at St. Bartholomew's Hospital Medical College, to be professor of pathology (British Postgraduate Medical School).

The title of emeritus professor of bacteriology in the University has been conferred on Prof. William Bulloch on his retirement from the Goldsmiths' Company's chair of bacteriology at the London Hospital Medical College, and that of emeritus professor of ethnology in the University on Prof. C. G. Seligman on his retirement from the University chair of ethnology at the London School of Economics.

The Council of East London College has recently conferred on Dr. Allan Ferguson the title of assistant professor in the Department of Physics.

"FRIENDS of the Hebrew University of Jerusalem" in London held their annual meeting on July 16. Since its dedication in April 1925, when it had no regular students but was composed of three research departments, the University has developed rapidly. Other research departments have been added and regular undergraduate instruction has been organised in a faculty of humanities and a division of biological studies, the former having now 253 students, including 21 graduates, and the latter 68. It has institutes and departments of Jewish studies, oriental studies, general humanities, mathematics, physics, biological and colloidal chemistry, inorganic and applied chemistry, Palestine natural history, parasitology and hygiene and bacteriology; a school of agriculture is projected for 1934–35 and the erection of a university hospital with a postgraduate school of medicine and hygiene are contemplated. Since the world economic depression set in, its annual income has shrunk from £50,000 to £40,000, but this has not prevented continued growth. It receives no grant to its regular budget from any public exchequer and the major part of its income is derived from annual contributions of which, hitherto, more than two thirds have come from the United States. The London friends have helped during the past year with donations of money and books and by making known the University's requirements, especially in connexion with German Jewish refugees. Nine displaced German professors have found refuge in the University. Glasgow, Liverpool and Manchester friends have all given valuable help, and a society of Palestine friends has lately been formed and has endowed a Bialik chair of Hebrew.

Science News a Century Ago

Darwin at Valparaiso

Under the date July 23, 1834, Darwin in his "Journal" says "the *Beagle* anchored late at night in the Bay of Valparaiso, the chief seaport of Chile. When morning came, everything appeared delightful. After Tierra del Fuego, the climate felt quite delicious —the atmosphere so dry and the heavens so clear and blue with the sun shining brightly, that all nature seemed sparkling with life. The view from the anchorage is very pretty. . . . In a north-easterly direction there are some fine glimpses of the Andes; but these mountains appear much grander when viewed from the neighbouring hills; the great distance at which they are situated, can then more readily be perceived. The volcano of Aconcagua is particularly magnificent. This huge and irregular conical mass has an elevation greater than that of Chimborazo; for, from measurements made by the officers in the *Beagle*, its height is no less than 23,000 feet. The Cordillera, however, viewed from this point, owe the greater part of their beauty to the atmosphere through which they are seen. When the sun was setting in the Pacific, it was admirable to watch how clearly their rugged outlines could be distinguished, yet how varied and how delicate were the shades of their colour."

Sturgeon on Electrical Kites

When William Sturgeon (1783–1850), the inventor of the electro-magnet, was living at Woolwich he used to experiment with kites and, through a startling

experience, on July 23, 1834 he addressed a letter to the Editor of the *Philosophical Magazine* entitled "Caution to Experimenters with the Electrical Kite". A day or two previously, when clouds had begun to gather, he had gone to the Artillery Barracks ground with an electric kite, got it afloat letting out string through his hands from a coil thrown on the ground. "When about a hundred yards of the string had been let out," he says, "a tremendous discharge took place, which gave me such a blow in the chest and leg that I became completely stunned, let go the string and consequently the kite soon fell." Sturgeon blamed himself for the accident, and after explaining the precautions which should be taken concluded "young persons who are fond of kite flying should also be cautious not to have their kites up during thunder storms, as it is possible that a wet string may transmit a violent discharge, from which a serious accident may occur."

Whewell on Inductive Science

When Whewell held the chair of mineralogy at Cambridge, he planned a series of treatises on the progress of knowledge. When considering the method of dealing with his subject, he corresponded with the political economist, the Rev. Richard Jones (1790–1855) and in a letter dated July 27, 1834, said: "You are to understand that I am to consist of three Books. Book I *History* of Inductive Science, namely, Astronomy, Mechanics, Physics, Chemistry and Botany historiographized in a new and philosophical manner. Book 2 *Philosophy* of Inductive Science, which is what I want to shew you. It will be dry and hard, I fear, as it must contain most of the metaphysical discussions which have been alluded to of late, but it must also contain all the analysis of the nature of Induction and the Rules of its exercise, including Bacon's suggestions. Book 3 *Prospects* of Inductive Science. The question of the possibility and method of Applying Inductive processes as illustrated in the philosophy of Book 2, to other than material sciences; as philology, art, politics and morals."

Launch of H.M.S. *Pique*

On July 28, 1834, the *Times* recorded the launch at Plymouth of H.M. Frigate *Pique*, 36 guns. The surveyor, or chief constructor, of the Navy was then Captain (afterwards Admiral Sir William) Symonds (1782–1856) who had been appointed to the post in 1832 in succession to Sir Robert Seppings. The *Pique*, said the *Times*, was built upon the plan of Captain Symonds, "who has now, we believe, had the construction of ten ships of war upon his fundamental principles, as a naval architect—that great breadth imparts to a vessel greater stability, or a capability of sustaining an inclined force at the least angle of inclination. This position must be undoubtedly true; but it is contended that its development has been carried to a degree of extravagance from which no desirable advantage whatever has been experienced, while the expense has been enormous. . . . The dimensions of the *Pique* are length of lower deck, 160 feet, breadth extreme 44 feet, depth of hold 13 feet 9 inches, tonnage 1,400 tons. She has been constructed under the able directions of Thomas Roberts, Esq., the veteran ship-builder of Plymouth dockyard, who has now completed the 50th man-of-war launched since his advancement to his present honourable rank."

Societies and Academies

London

Mineralogical Society, June 7. C. PALACHE: The form relations of the lead oxychlorides, laurionite, paralaurionite, and fiedlerite. The separate identity of each of the first two minerals is confirmed and their homoeomorphism is exhibited by a re-orientation of laurionite. The form series of fiedlerite has been simplified by the choice of a new unit form. New forms are described on paralaurionite and fiedlerite. The crystallography of all three species is summarised in new angle-tables, and their habits are illustrated by a series of drawings. F. A. BANNISTER: The crystal structure and optical properties of matlockite (PbFCl): W. Nieuwenkamp's recent work proving the identity of matlockite with artificial lead fluochloride, PbFCl, has been confirmed. New chemical analyses, X-ray work and optical measurements have been carried out on single crystals of matlockite from Cromford, Derbyshire. Single crystal photographs of the mineral have also confirmed the crystal structure proposed for artificial PbFCl. Artificial BiOCl, BiOBr and BiOI have crystal structures of the same type, and the relationship between matlockite and these and other compounds is discussed. Artificial Pb_2OCl_2 has a crystal structure quite different from that of matlockite. Mendipite, $Pb_3O_2Cl_2$, contains no fluorine, and it is improbable that fluorine has been overlooked in the oxychloride minerals from Laurium, Greece. V. ZSIVNY and L. ZOMBORY: Berthierite from Kisbánya, Carpathians. This rare mineral, previously known from two localities in old Hungary, is now described from a third, namely Kisbánya in comitat Szatmár (now Chiuzbaia in Satu Mare, Roumania) where it occurs as bundles of needles with stibnite and rhombohedral carbonates. Analysis agrees closely with the formula $FeS.Sb_2S_3$, but the specific gravity 4·65 is much higher than values previously recorded. L. J. SPENCER: Beryllium minerals (euclase and phenakite) from Africa. Apart from beryl, there are very few recorded occurrences of beryllium minerals in the whole of Africa. Euclase is described from pegmatite on the Lukangasi mica claim, Morogoro district, Tanganyika Territory. The main crystal on the single specimen collected measures 7·2 cm. by 3·5 cm., being much larger than any euclase crystal hitherto known. Seventeen crystal forms were determined. Small crystals of phenakite from pegmatite at the Klein Spitzkopje, South-West Africa, are of two distinct habits, prismatic and lenticular. A. C. SKERL and F. A. BANNISTER: Lusakite, a cobalt-bearing silicate from Northern Rhodesia. The mineral occurs embedded in quartz-magnetite-kyanite-rock of gneissoid appearance from 80 miles east of Lusaka. Crystals, generally tabular to (010) varying up to 5 mm. in length, are black in hand-specimens, but show a deep cobalt-blue colour, and strong pleochroism in thin section. The mean refractive index is approximately 1·74 and $2V$ is near 90°. Oscillation, Laue, and rotation photographs show that lusakite has an orthorhombic unit cell with edges a 7·86, b 16·62, c 5·63 A., and space-group V_h^{17}. The unit cell contains 8 [$RO.Al_2SiO_5$] where R represents Fe, Co, Ni, Mg, Al, and H. The cobalt content is unique for a silicate and reaches $8\frac{1}{2}$ per cent CoO, or nearly two atoms of cobalt per unit cell. It is almost identical in physical properties with staurolite, and X-ray photographs show that it possesses the same type of crystal structure. A. W. GROVES: The

determination of small amounts of copper in rocks. The paper describes the application to silicate analysis of the sodium diethyl-dithio-carbamate colorimetric method for copper. Data on the retention of copper by the ammonia precipitate are given. The method has a range of 0·001–0·25 per cent CuO when a sample of 2 grams is used. L. J. SPENCER: Thirteenth list of new mineral names. A dictionary list of 112 names collected from the literature of the past three years. Since the first list in 1897, a total of 1,918 names has been collected. L. J. SPENCER: A new meteoric stone from Silverton, New South Wales. A beautifully oriented stone weighing 351 grams was found by Mr. R. Bedford amongst debris in the old museum at Port Adelaide, which has recently been reorganised as a Nautical Museum. It probably dates from the time (1883) of the discovery of the rich mineral deposits at Broken Hill in the Silverton district. The stone is a white hypersthene-olivine-chondrite of the Baroti type with only little nickel-iron. M. H. HEY: Studies on the zeolites (8). A theory of the vapour-pressure of zeolites. An equation for the water vapour pressure of a zeolite (or other compound showing similar dissociation phenomena) is derived on simple kinetic grounds, and is shown to agree reasonably well with the available experimental data. The equation, which can only be a first approximation to the truth, is compared with other equations previously proposed. Kinetic treatment also leads to a reasonable equation for the rate of diffusion of water within a zeolite crystal. The condition of the water in the zeolites is discussed.

EDINBURGH

Royal Society, June 4. H. BRIGGS: (1) Graphical classification of carbonaceous minerals: the mineral oils. The graphical method adopted in previous papers relating to the evolution of carbonaceous minerals is extended to oils. The inclusion of mineral resins indicates their connexion with the heavy and light crude oils. The 'development lines' for the oils eventually merge with the coal belt at the stage of the lignites, thus supporting the view that coal and oil were derived from similar raw material, but by divergent courses of chemical evolution. Bischof's hypothesis to the effect that "the most dissimilar substances may be produced from ligneous fibre, according to the nature of the change" is thus revived. (2) Products of the natural development of coal and oil. The products of the maturing process, water, methane and carbon dioxide, are discharged in varying proportions during different stages of the evolution. Equations are constructed connecting the amount of these compounds, the slope of the 'development line' of the fuel, and the loss in weight during the transformation, with the percentages of oxygen at the beginning and end of the phase. Obtaining loss of weight from field and other sources, the equations are solved and the discharges of water, methane and carbon dioxide ascertained. The derivation of anthracite from semi-bituminous coal requires the consumption instead of the discharge of water. Also the generation of oil from vegetable matter involves the appearance of water on the left-hand side of the equation. MARY G. CALDER: Notes on the Kidston collection of fossil plant slides. (5) Structure of two Lower Carboniferous Lepidodendroid stems, one of the *Lepidophloios Wünschianus* type, and the other of the *Lepidodendron fuliginosum* type. The anatomy of two Scottish Carboniferous Limestone stems, labelled by Kidston as a new species "*Lepidodendron Langi*", is described. One stem, from Cadder, is referred to *Lepidophloios Wünschianus*, Carruthers sp.: the other, from Carluke, is referred to *Lepidodendron fuliginosum*, Williamson, and is discussed in relation to the British Carboniferous 'plant-break'. (6) Structure of two Lepidodendroid stems from the Carboniferous flora of Berwickshire. Two species of *Lepidodendron* from Calciferous Sandstone rocks in Berwickshire are discussed. One of them, to which Kidston had given the MS name of "*Lepidodendron Macconochiei*", is referred to *Lepidodendron brevifolium*, Williamson: and the other is referred to *Lepidodendron* sp. JESSIE A. R. WILSON: A new species of *Psygmophyllum* from the Upper Carboniferous of Scotland. A new species of *Psygmophyllum* from the Upper Carboniferous of Scotland is described and figured. The material upon which this new species is founded was discovered in Coal Measure shales exposed in the bank of the River Nethan, near Crossford, Lanarkshire, Scotland, and consists of two slabs of shale bearing four isolated leaf-impressions. These leaves measure about 5 cm. in length and show a single bifurcation of the lamina. This new species, the first record of a *Psygmophyllum* from the Carboniferous rocks of Scotland, has been named *Psygmophyllum scoticum*. J. S. HUNTER: The photoelectric thresholds of some turned metallic surfaces. Long wave-length photoelectric thresholds have been determined for the turned surfaces of the metals copper, silver, antimony, bismuth, tin, lead, nickel, iron, zinc, aluminium, brass and cast steel. These thresholds are found to be at 2985 A., 3200 A., 2996 A., 3075 A., 3000 A., 3060 A., 3125 A., 2980 A., 3225 A., 3740 A., 3025 A., and 2916 A. respectively. The photoelectric currents were measured by a valve electrometer circuit. The above thresholds are found to approximate to those for the same metals in the partially out-gassed state. It is concluded that a turned surface is one which is partially denuded of occluded gases. ROBERT SCHLAPP: Note on the electron configurations p^2s, p^4s. The secular equations for the energy-levels of these configurations, inclusive of orbit-spin interaction, are set up by treating the electrostatic exchange energy of two electrons as formally equivalent to a magnetic coupling between their spins (Dirac, Van Vleck). The equations are expressed in terms of three parameters, giving respectively the coupling between the equivalent electrons, the coupling between the s electron and the core, and the orbit-spin coupling. The g-values are found as functions of these parameters. The levels are compared with those observed in As I, agreement being reasonably good.

PARIS

Academy of Sciences, May 28 (*C.R.*, **198**, 1889–1952). A. COTTON and TSAÏ BELLING: The magnetic double refraction of oxygen and nitrogen in the gaseous state and of aqueous solutions of chlorates. These experiments were carried out with the Bellevue magnet, with the addition of a supplementary coil. PIERRE WEISS: The variation of saturation magnetisation at low temperatures. The $T^{3/2}$ law. The T^2 law proposed by Weiss and Forrer expresses the experimental figures for iron and nickel down to 90° K., but below that temperature the $T^{3/2}$ law appears to agree better with the measurements. BERTRAND GAMBIER: Tetrahedra conjugated to a quadric Σ and to tangent edges of a quadric S. Tetrahedra of which the edges are tangent to two

quadrics S, S'. PIERRE BOOS: A characteristic property of surfaces of revolution. K. NIKOLSKY: The equation of the photon. ROBERT FORRER and MLLE. A. SERRES: A new magnetic phenomenon: increasing paramagnetism superposed on diamagnetism in alloys with a false Curie point. NICOLAS PERAKIS and LÉANDRE CAPATOS: The magneto-chemistry of rhenium. Metallic rhenium and heptavalent rhenium. RENÉ AUDUBERT and JEAN ROULLEAU: The influence of polarisation on the effects of electrolytic selenium photocells. P. JACQUET: The adherence of electrolytic deposits of copper. M. GUILLOT and M. HAÏSSINSKY: The reduction of polonium in solution. A. MICHEL and G. CHAUDRON: The transformations of pyrrhotine and of ferrous sulphide. P. GOLDFINGER and L. SCHEEPERS: A micromethod for the determination of heavy water. The construction and mode of use of a float is described by means of which densities on 0·1–0·2 c.c. of liquid can be determined with an accuracy of one unit in the fifth place. JEAN BUREAU: The diagram sodium nitrite, water. The hydrate $NaNO_2 . 0{\cdot}5H_2O$. F. BOURION and MLLE. O. HUN: The determination of the total hydration of the ions of potassium bromide. A. BOUZAT and M. SCHMITT: The determination of azeotropic compositions. The azeotropes of benzene and cyclohexane. P. LAFFITTE and P. GRANDADAM: The direct oxidation of platinum under pressure. Platinum black, heated in oxygen under a pressure of 40 atmospheres, fixes the maximum proportion of oxygen at temperatures between 450° and 460° C. At higher pressures there are indications of the formation of mixtures of PtO and PtO_2: the latter has been isolated. B. BOGITCH: Some properties of silver silicate. The yellow colorations of glass produced by silver are probably due to the formation of silver silicates. R. DELAVAULT: The mechanism of the oxidation of magnesium alloys at a high temperature. When the magnesium contains ten per cent or less of foreign constituents, the oxidation of the heterogeneous metal starts through a liquid phase showing protuberances offering a large surface of contact with the air. OCTAVE BAILLY and JACQUES GAUMÉ: An unexpected mode of formation of the monoester of β-glycerophosphoric acid. RENÉ TRUCHET and JEAN CHAPRON: The Raman spectrum of conjugated double links in a nucleus. The Raman spectra of cyclopentadiene and dicyclopentadiene are given. Cyclopentadiene resembles furane, pyrrol and thiophene in giving a strong Raman line at 1400–1500 cm.$^{-1}$. From this it is concluded that the existence of the 1580 line for benzene furnishes no argument for rejecting the Kékulé formula. J. FLANDRIN and G. LUCAS: The age of the deposits with Medjanian facies of Djebel Morissane (Department of Constantine). NICOLAS THÉOBALD: The fossil insects of Kleinkembs (Pays de Bade). A study of about 1,000 specimens collected by Mieg and presented to the Basle Natural History Museum. ALPHONSE LABBÉ: The obscure penial gland of the Silicoderms. MME. LUCIE RANDOIN and MLLE. SUZANNE QUEUILLE: Can the evolution of A avitaminosis be influenced by the nature and proportions of the proteins of the basic regime? RENÉ HAZARD: Some physiological actions of sarothamnine and genisteine. W. KOPACZEWSKI: The rôle of the physical factors in the lacto-gelification of serum. MME. N. DOBROVOLSKAIA-ZAVADSKAIA and P. ZÉPHIROFF: A substance isolated from adenocarcinoma of the udder of mice, capable of activating the growth and advancing genital development in young rats.

Official Publications Received

GREAT BRITAIN AND IRELAND

British Non-Ferrous Metals Research Association. Fourteenth Annual Report and Notes on Researches in Progress for the Year ending December 31st, 1933. Pp. 48. (London.)

Department of Scientific and Industrial Research. Report of the Radio Research Board for the period 1st January 1932 to 30th September 1933. Pp. iv+137+4 plates. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

British Science Guild. The Annual Report of the Council of Management, 1933–1934, presented at the Annual General Meeting held at the Royal Society of Arts, London, on Tuesday, 12th June 1934. Pp. 31. (London.) 1*s*.

Papers of the Greenock Philosophical Society. Britain's Coal Problems: being the Watt Anniversary Lecture for 1934 delivered before the Society on 2nd March 1934. By Prof. William A. Bone. Pp. 30. (Greenock.)

Department of Scientific and Industrial Research. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1933. Part 2. Pp. iv+108+8 plates. (London: H.M. Stationery Office.) 3*s*. net.

Empire Cotton Growing Corporation. Report of the Administrative Council of the Corporation submitted to the Thirteenth Annual General Meeting on June 14th, 1934. Pp. ii+72. (London.)

The Royal Society for the Protection of Birds. Forty-third Annual Report, January 1st to December 31st, 1933; with Proceedings of Annual Meeting 1934. Pp. 54. (London.)

Joint Board of Research for Mental Disease: City and University of Birmingham. Annual Report, 1933–1934. Pp. 14. (Birmingham.)

Ministry of Agriculture and Fisheries. Guide to the Licensing of Bulls in England and Wales. Pp. 15. (London: Ministry of Agriculture and Fisheries.)

OTHER COUNTRIES

Bulletin of the Madras Government Museum. New Series, Genera Section, Vol. 1, Part 3: Tiruparuttikunram and its Temples, with Appendices on Jaina Units of Measurement and Time, Cosmology and Classification of Souls. By T. N. Ramachandran. Pp. ix+260+37 plates. (Madras: Government Press.) 11.4 rupees.

Commonwealth of Australia: Council for Scientific and Industrial Research. Catalogue of the Scientific and Technical Periodicals in the Libraries of Australia. Supplement 1928–1933. Edited by C. A. McCallum and D. W. I. Cannam. Pp. xx+453. (Melbourne: Council for Scientific and Industrial Research.) 5*s*.

Records of the Indian Museum. Vol. 36, Part 1: Notes on Fishes in the Indian Museum. 22: On a Collection of Fish from the S. Shan States and the Pegu Yomas, Burma. By Sunder Lal Hora and Dev Dev Mukerji. Pp. 123–138. (Calcutta.)

Memoirs of the Geological Survey of India. Vol. 64, Part 2: Asbestos in the Ceded Districts of the Madras Presidency, with Notes on its Occurrence in other Parts of India. By Dr. A. L. Coulson. Pp. vii+143–266+xx+plates 6–10. (Calcutta.) 3.8 rupees; 6*s*.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 79: The "Lucerne Flea" *Smynthurus viridis* L. (Collembola) in Australia. By Dr. J. Davidson. Pp. 66+5 plates. (Melbourne: Government Printer.)

Smithsonian Miscellaneous Collections. Vol. 89, No. 15: World Weather and Solar Activity. By H. Helm Clayton. (Publication 3245.) Pp. 52. Vol. 91, No. 2: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—New Mollusks of the Family Turritidæ. By Paul Bartsch. (Publication 3229.) Pp. 29+8 plates. Vol. 91, No. 12: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—Three New Amphipods. By Clarence R. Shoemaker. (Publication 3246.) Pp. 6. Vol. 91, No. 13: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—A New Genus of Brittlestars from Puerto Rico. By Austin H. Clark. (Publication 3248.) Pp. 3+1 plate. Vol. 91, No. 14: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep—A New Starfish from Puerto Rico. By Austin H. Clark. (Publication 3249.) Pp. 3+1 plate. (Washington, D.C.: Smithsonian Institution.)

Union of South Africa: Department of Mines. Geological Series, Bulletin No. 1: The Witwatersrand System in the Klerksdorp-Ventersdorp Area; a Preliminary Report. By Dr. Louis T. Nel. Pp. 32+2 plates. 1*s*. Geological Series, Bulletin No. 2: The Andalusite Sands of the Western Transvaal. By F. C. Partridge. Pp. 16. 6*d*. (Pretoria: Government Printer.)

Bulletin of the Michigan College of Mining and Technology. New Series, Vol. 7, No. 3: General Information for the Year 1934–1935. Pp. 153. (Houghton, Mich.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 2, Part 10: Normenresttheorie galoisscher Zahlkörper mit Anwendungen auf Führer und Diskriminante abelscher Zahlkörper. Von Helmut Hasse. Pp. 477–498. 40 sen. Section 3: Botany. Vol. 4, Part 3: Anatomical Studies on some Leguminous Leaves with Special Reference to the Vascular System in Petioles and Rachises. By Shunji Watari. Pp. 225–365+plates 5–8. 2.90 yen. (Tokyo: Maruzen Co., Ltd.)

CATALOGUES

Africana: a Catalogue of Books, Maps and Pictures. (1934, No. 2.) Pp. 26. (London: Francis Edwards, Ltd.)

Catalogue de Livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 27.) Pp. 403–472. (Paris: Libr. Adrien-Maisonneuve.)

Photography as an Aid to Scientific Work. Pp. 8. (Ilford: Ilford, Ltd.)

B.D.H. Chlorotex Outfit for Determination of Free Chlorine in Swimming Pools and Drinking Water. Pp. 4. Acriflavine, Euflavine and Proflavine. Pp. 20. (London: The British Drug Houses, Ltd.)

SATURDAY, JULY 28, 1934

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CONTENTS

The Planning of Research

ALTHOUGH the social reactions of science are now widely realised and the dynamic nature of science is also perceived, the idea that society itself is dynamic and not static has yet to be grasped. Once this fundamental conception has been realised by the general populace, effective attempts can be made to utilise the scientific method and outlook to release our social order from many of the disorders which it has incurred. The attention which is to be paid at the forthcoming British Association meeting in Aberdeen to the relations between the advance of science and the life of the community is definite evidence that the idea is gaining ground, and although speakers at that meeting may feel they are 'preaching to the converted', the consequent focusing of public opinion on the subject cannot be other than helpful.

Among other attempts in recent months to face these issues and to stimulate discussion may be mentioned the further statement on "Liberty and Democratic Leadership" issued early this year over a large number of representative signatures, which referred particularly to housing, the stimulation of consumption and the organisation of distribution, and the survey of scientific research in relation to social needs described by Prof. Julian Huxley in his recent book "Scientific Research and Social Needs". Apart altogether from his valuable account of research activities in progress, Prof. Huxley poses a number of fundamental questions which require attention before we can outline any adequate programme of research in relation to social problems. Something much more than scientific research in the narrow speculative sense is required : we need also the scientific spirit and method in the shape of careful planning.

The map of scientific research which Prof. Huxley attempts to draw is in itself an important preliminary to such planning. It reveals at once the lopsided development of the scientific structure of Great Britain and the lamentable neglect of the sciences dealing with man. The imperative necessity of organising research less from the production side and more from the consumption end towards the needs of the individual citizen also emerges, and these two factors alone throw a flood of light on the real causes of the displacement of labour or technological unemployment.

If science is to fulfil its function in the modern State, we must, in fact, regard it as a social activity

and not as something apart from the rest of human life and interest. Not only is sharp distinction between pure and applied science no longer possible, but also the scientific movement as a whole requires scientific study, and its activities must be planned as much as any other social or industrial activity, if the maximum results are to be obtained and its resources wisely exploited. This planning of science must precede the wider participation of the scientific worker in social activities. Through it must come the assembly and exploration of the scientifically ascertained facts in neglected fields, upon which alone wise action can be based.

It is probably at this point that such organisations as the Royal Society, the British Association, the British Science Guild, the Federation of British Industries, the Association of Scientific Workers might render valuable service. Through their efforts it should be possible to map out the scientific resources of the country, and make authoritative recommendations for the re-orientation of these resources and for the attack on neglected problems of outstanding importance. An important instrument in this respect would obviously be the newly reconstituted Parliamentary Science Committee.

Some of the more conspicuous gaps demanding such a re-distribution of scientific effort from the physical sciences into the biological and related sciences, as urged by Sir Josiah Stamp at the British Association meeting at Leicester last year, may be briefly indicated. In regard to agriculture, for example, even on the production side, many of the scientific results already available could be applied immediately to reduce costs for the farmers and enable more of them to make a reasonable and assured profit instead of living from hand to mouth with failure a persistent menace. On the other side, with very large sections of the population underfed and undernourished, the resources of science should be capable of ending the restriction of output and sabotage. The proper application of existing knowledge could at least double the production of food in Great Britain and raise world production to a level which would provide the population with a sufficiency of the right types of food to ensure full health and growth and energy for all.

Here, as in such questions as adequate housing, town and country planning, the utilisation of scientific results involves economics and politics. Without the large-scale planning of industry, science is liable to cause as many difficulties as it resolves. There is all the more reason therefore for applying scientific methods not only to technology and production but also to the organisation of particular industries and to the economic life of the nation as a whole. Any subject is capable of examination by the scientific method, and consumption is just as much a problem for scientific research as is production.

Even in regard to industry in the more limited sense, there are gaps in the existing structure of research which should be filled by such re-orientation of scientific resources. Taken as a whole, industry appears to be unwilling or unable to provide the broad scientific background of research out of which new applications grow, or to undertake long-range fundamental investigation on a large scale. The standardisation of materials and processes alone offers a field for much more extensive research, which would have important social as well as economic results, and frequently provide traditional methods and standards with a scientific foundation, thus making improvement possible. As craftsmanship thus becomes based on scientific data instead of half-conscious knowledge, technical obstacles to social progress in such fields as building, for example, are more readily removed.

The improvement of processes, the introduction of new processes and products, and the development of new uses for materials are all ways in which in many industries research needs organising and directing in a wider and more effective manner. This involves very often the acquisition of the scientific spirit by the management of industry, and the facing of the whole question of training for management. Next to nothing has yet been done in the scientific study of consumption and distribution. A really scientific investigation of how to stimulate consumption, or into retail distribution, is required to obtain the facts essential for scientific decision as to a policy for action.

The idea of regarding society itself as a proper object for scientific research is new to many, but is quite definitely forced on us by such surveys as that carried out by Prof. Huxley and the situation it reveals. Moreover, the scientific worker can scarcely be in any doubt that a scientific attitude to social questions is better than an unscientific one. There are many problems presented in education, the penal system, public health and industrial welfare, in which a proper supply of scientifically ascertained facts is an indispensable preliminary to wise action. Notably does the study

of population with the view of controlling it offer attractive possibilities.

The merest glimpse of the possibilities of improving the quality of human life in this way which emerges from such a survey should be sufficient incentive to the mobilisation of scientific forces to this end. To fill in the gaps which exist in research by national direction and planning of research is a first step, and may demand, as suggested by Prof. Huxley, the creation of a social advisory committee and research council corresponding to those responsible for planning and financing research in the economic field. Such a council would not only be able to plan out the lines of an adequate campaign of research, but also would assist in obtaining the necessary supply of research workers trained in the social sciences by modifying both the distribution of scholarships awarded in different branches of science and the science curricula in schools and universities.

Action along such lines is essential in the acquisition of scientific knowledge of the possibilities of changing society and solving our social problems if that knowledge is applied. To secure that application and exercise such control over society is another matter. Even in such matters as health there are all kinds of obstacles to be overcome. Poverty, religious prejudices, vested interests, public ignorance and apathy, and sectionalism are all barriers to action based on knowledge and to planning on a national scale. Moreover, the group mind itself is normally much more self-centred and backward than that of the average individual forming the group, and planning on a national scale has in itself at least the possibilities of further friction and obstacles to wider developments through the development of international friction. The exploitation of science for sectional ends, however large, may actually intensify present rivalries and create further chaos before men learn to subordinate their sectionalisms to the claims of the world unit and co-operation on an international scale.

The outstanding progress in every field of human activity and happiness, which is really within our grasp if science were applied in the international scale as thoroughly and efficiently as it is at present within the limits of a single business or a single industry, holds out every inducement to overcome the difficulties which private profit or national sovereignty present. After all, if the form and direction of science itself are largely determined by the social and economic needs of the place and period, even in the international sphere science is influencing the world structure. Here as elsewhere it is making for the breakdown of the system which gave it birth, and demanding the creation and development of a new order in which the needs of mankind can be more effectively served. The conception of science as a social function intimately linked up with human history and human destiny, moulding and being moulded by social forces, should summon forth from scientific workers something of the energy required to translate into policy and action the knowledge acquired by their work. Such energy will find its expression alike in the discharge of their own civic responsibilities and in sharing with their fellow citizens both this vision of the new and greater social possibilities if that knowledge is sincerely and courageously applied, and the faith that human reason by using wisely the scientific method can give us the control of our destiny.

Electroacoustical Reproducers

Loud Speakers: Theory, Performance, Testing and Design. By Dr. N. W. McLachlan. (Oxford Engineering Science Series.) Pp. xii+399. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 40*s*. net.

A PERUSAL of recently published textbooks on acoustical matters reveals that the major problems associated with the design and operation of reproducing equipment are dismissed with provoking brevity, or politely ignored. It is a source of some wonder that until now this subject of such vital concern to all designers of wireless receivers should have the singular distinction of being overlooked by the vigorous band of technical authors. Yet such is the case with but trivial exceptions. However, in this third and massive volume of the Oxford Engineering Science Series, Dr. McLachlan has dealt with the broad subject of loud speakers in a fresh and thoroughgoing manner. The treatment of the multifarious topics has been as mathematical as the themes allow, and on the theoretical side is strikingly complete. The author has been such a prolific contributor to the knowledge of the subject himself that we have good grounds for expecting the information to be up to date and authoritative.

The widely scattered and recent literature on loud speakers has been drawn together in an excellent way, and the bibliography is particularly well set out, while the reliability of the statements

made is of a high order. But the book is much more than a full account of Dr. McLachlan's own work plus excerpts from British, German and American technical literature. It contains many paragraphs of original and hitherto unpublished work which is the hall-mark of a good textbook. These have been inserted at the time of writing to complete the various discussions, and they are found especially in the more theoretical portions of the book. Incidentally the author has also found time and energy to write a separate book dealing with the special Bessel functions involved, and this should provide an easy approach to the more difficult portions of the present text.

The volume under review has been written from a scientific rather than from a manufacturer's point of view, and those associated with the development of reproducing equipment will find certain topics of paramount importance only briefly referred to. Mention may be made of the step-down transformer, a standard fitting on practically all modern moving-coil loud speakers, the discussion of which is limited to a few lines. No reference is made to the usual method of introducing a small fixed air-gap into the iron circuit to prevent serious anode current polarisation of the transformer core. In fact, the word 'transformer' is not even in the index. Centring devices for voice coils are likewise dismissed in less than a page, while concerning the all-important matter of the choice of cone angle, we are merely told "that for general reproduction an angle midway between a disk and cylinder gives the best results". In actual moving-coil loud speaker practice, apical angles ranging between 90° and 140°, in steps of 5°, are to be found among the vast range of modern commercial instruments. However, these are defects which to some extent are due to the paucity of published data and must not be taken as truly representative of a textbook which was not written primarily to solve the troubles of the harassed designer. Nevertheless, he cannot fail to find some of his difficulties discussed within its covers, and the solutions given.

Turning our attention to a more detailed consideration, we find that after a complete list of symbols and a chapter on definitions the formal theory of propagation of sound is developed with loud speaker problems clearly in view. For example, the vibration in different modes of the ideal sphere is considered in detail, and the results are applied to explain the action of baffles on diaphragms, and practical conclusions are drawn.

Following a formal consideration of the accession to inertia of disk and spherical vibrators, is an interesting chapter on vibration modes curiously sandwiched between two other formal and excellent chapters on the calculation of the spatial distribution of sound from vibrating diaphragms of various shapes and on the theoretical acoustical power radiated. A commendable feature of these early chapters is the inclusion of clear tables summarising the solutions for special boundary conditions.

The theory of the moving-coil principle and the calculation of the coil-driven rigid disk occupy the next two chapters, and after this there are chapters devoted to electrostatic speakers, the theory of horns, sound waves of finite amplitude, and transients. This concludes the analytical portion of the book.

Under the heading of driving mechanisms, are briefly described the principal types of loud speaker motor, and all the well-known principles are mentioned. Magnets are adequately discussed from the aspects of measurement and design and a full treatment is given of the influence of non-uniform gap flux distribution. Further sections deal with questions of acoustical efficiency, its definition and measurement, electrical impedance determinations and the quantities deducible therefrom. The bridge shown in Fig. 107 is preferably described as the 'Heaviside-Campbell', especially in the form given. A wealth of information is given in these experimental chapters and much timely warning of likely pitfalls.

Response curves and their measurement are next considered, and a good selection of results is given. In subsequent editions an expansion of the section giving details of suitable testing apparatus would be advantageous to those readers about to undertake response measurements for the first time. A comprehensive discussion of the vibrational frequencies of conical shells concludes the experimental portion of the book, and this is a subject that Dr. McLachlan has made peculiarly his own. A valuable elucidation of a difficult set of phenomena is given in this chapter and the research worker in this field will find many of the explanations put forward eminently helpful.

In the concluding section embracing two chapters, design calculations on hornless and horn type moving-coil loud speakers are given and many useful formulæ developed. Several interesting topics are also included in an appendix. It was good to see the recent equal loudness contours of Fletcher and Munson in Fig. 150, but the term

"isobel" is to be decried since loudness is not "measured in decibels", as the description of the ordinates in that figure would suggest. The word "level" inserted after "loudness" would improve matters considerably and makes an all-important distinction. In fact, "loudness" and "decibels" seem to have been inextricably mixed up in definition 46. The decibel should be defined without any reference to the fallacious Weber-Fechner law or to subjective aural impressions, but just simply in suitable terms as the logarithm of a power ratio. These points can be corrected in future editions, as this excellent volume has undoubtedly come to stay as a standard work.

The Clarendon Press is to be congratulated on the clarity of the production, the formulæ and illustrations being set out particularly well. Misprints, too, are few in number and are not of a serious nature. Finally, the book is warmly commended to research workers, teachers and advanced students of acoustical engineering.

D. A. OLIVER.

Pioneering in Chinese Palæontology and Archæology

Children of the Yellow Earth: Studies in Prehistoric China. By J. Gunnar Andersson. Translated from the Swedish by Dr. E. Classen. Pp. xxi+345+32 plates. (London: Kegan Paul and Co., Ltd., 1934.) 25*s.* net.

READERS of NATURE are aware of the important work accomplished by Dr. J. Gunnar Andersson in opening up the field of palæontology in China, and preparing the setting for the epoch-making work of the late Prof. Davidson Black, to whom he dedicates his book in these words: "This volume is dedicated to the memory of my charming friend Davidson Black (†March 15, 1934), Professor at the Peking Union Medical College, who with such penetrating genius identified and described *Sinanthropus pekinensis*."

Not only did Dr. Andersson discover the site of the earliest phase of human history, but he also recovered the earliest known cultural remains in China, which provided evidence to confirm the reality of the intimate connexion between the first civilisation of China and that of Western Asia, and convincing evidence of the derivation of Chinese culture indirectly from Mesopotamia, as suggested long ago, but without the conclusive evidence, by Prof. Terrien de la Couperie. The book he has written is not only a fascinating introduction to the early geological and cultural history of China, but also is deeply interesting as giving the great pioneer's account of the circumstances of his discoveries, written in a vivid and entertaining style which throws valuable light upon the personal factors of the international co-operation which led to such momentous results.

The simple and direct narrative is illuminated by reference to many personal incidents. A quotation will illustrate the method and qualities of the bright narrative of the book. The inauguration of the work is described in these terms:

"It was a little piece of stone which from the very beginning gave a definite direction to my work in China and from this beginning my fate unfolded throughout a decade of varied and shifting change in which the milestones bear the inscriptions: mining expert—fossil collector—archæologist."

Dr. Andersson gives a full account of the labours of the Swedish geologists that led to the discovery of *Sinanthropus*, and sheds illuminating glimpses of light on the personalities of the participants, European and Chinese, in this great achievement. The story of Dr. Andersson's location of the important site at Chou Kou Tien has often been told and is given again in this book with the personal authority of the finder:

"I could never forget the thought of the hominid remains in this cave and thus it happened that Zdansky, at my request, returned to Chou Kou Tien for further excavations in the summer of 1923. He found a molar and a premolar of a creature resembling a human being, which he designated merely *Homo sp.?* *So the hominid expected by me was found.*"

The cautious French palæontologist, P. Teilhard de Chardin, impressed upon Dr. Andersson the risk of identifying human remains from a mere tooth and suggested, no doubt remembering the incidents of the so-called Nebraska man, the desirability of making sure the tooth was not a carnivore's. Dr. Andersson replied that he placed complete reliance upon Zdansky's palæontological experience, more especially as he had made extensive investigations in the fossil carnivores of China and thus should be proof against the danger suggested by Teilhard. While this discussion was fresh in men's minds, there was a public dinner in Peking for the secretary of the French Academy of Sciences, at which everyone of importance in science in Peking and Tientsin was present to do honour to the distinguished visitor. Spirits ran

high towards the end of the dinner and pointed remarks flew like arrows across the table.

"Then," writes Dr. Andersson, "I was struck by a full bull's eye. 'Well, Dr. Andersson,' the inexhaustible and delightful Grabau exclaimed to me, 'how are things just now with the Peking man ? Is it a man or a carnivore ?' 'My dear Dr. Grabau, the latest news from Chou Kou Tien is that our old friend is neither a man nor a carnivore. It is rather something half-way between the two. It is a *lady* !' "

For some months after this bantering, the name of the discovery changed to the "*Peking Lady*".

Then Dr. Andersson provides a lucid summary of the reasons given by Dr. Davidson Black (in his serious scientific argument) for the creation of a new genus of the human family. It is in this entertaining way that Dr. Andersson blends gay and grave in giving a lucid and vivid account of the great research, and a vast amount of information concerning the geology, the fossil animals and plants of China. Then he explains how, as the range of the search for fossils extended, he was led into important discoveries of archæological material and how in studying painted pottery he was impressed by the close resemblance to the material found by Prof. Pumpelly at Anau in Russian Turkestan.

This charming book is an entertaining first-hand report of two discoveries of outstanding importance in human history ; and it will be welcomed for the intrinsic interest of the story no less than the information it affords in such delightful fashion.

G. ELLIOT SMITH.

Fibres under the Microscope

(1) *Modern Textile Microscopy.* By J. M. Preston. Pp. xi+315. (London and Manchester : Emmott and Co., Ltd., 1933.) 15*s*. net.

(2) *Textiles and the Microscope.* By Prof. Edward Robinson Schwarz. Pp. xi+329. (New York and London : McGraw-Hill Book Co., Inc., 1934.) 24*s*. net.

(1) FIBRES, like most things, need both to be looked at and looked into, if the best is to be made of them. For thousands of years we were satisfied with the unaided human eye and 'visible' light—such natural equipment still suffices, or is made to suffice, for general industrial purposes —but lately we have begun to make use, not only of the microscope, but also of the 'light' of the X-rays. The immediate result has been, of course, to show how little we understand well about fibres, those elongated structures that are so common a feature of the architecture of living things ; but we are making good progress, and the times are full ready to receive an authoritative statement on the present position of textile microscopy.

This makes it rather a pity that the author of "Modern Textile Microscopy" has perhaps not made the most of the opportunity : the subject, especially at this juncture, was worth something more than he has put into it, a more systematic arrangement of the sections, for example, more explanation of the difficult parts and less of the easy parts, more thorough and convincing discussion of the fundamental structural aspects, and lastly, more careful scrutiny of the proofs to eliminate misprints and grammatical faults. "Modern Textile Microscopy" is a valuable book for all that, if only for the range of problems dealt with or touched upon and the comprehensive bibliography of 351 references, for much of the literature on textiles is depressingly confined to immediate practical affairs, with never a thought for the fundamentals and the great possibilities that surely still remain.

The treatment proceeds from the microscope and the preparation of sections and other experimental material, through photomicrography, photometry, staining, swelling, ultra-microscopy, the appearance of surface structures, and fluorescence microscopy, to a final chapter on the methods of polarised light. This last chapter might have been the best, the most suggestive for the problems that await solution and for the linking-up of optical with still deeper molecular studies—but somehow it is not : the confused definition of birefringence (p. 270) and the tangle in which Wiener's provocative formula has been left (p. 267) are alone sufficiently disappointing, even were the argument less superficial than it is. The correct interpretation of birefringence measurements on fibres under various conditions and after various chemical and physical adventures is difficult, very difficult ; but that makes it all the more imperative to set out clearly what we know and what we do not know. There was a golden opportunity here !

Much the larger part of Mr. Preston's book is devoted to cellulose fibres : the protein fibres, wool and silk, have not yet come into their own, optically at least, though undoubtedly they will

have far more to teach in the end. But cellulose, thanks to the recent happy combination of chemical and X-ray results, is in a very promising state. The reader should beware, however, especially if he is minded to apply a little physics to biology, of taking seriously what is said on p. 193 about the extinction directions in the cellulose wall of *Valonia ventricosa*. The original paper says something quite different.

(2) "Textiles and the Microscope", as the respective titles somehow suggest, has not quite such high aims, whether or not they have been realised, as "Modern Textile Microscopy". Prof. Schwarz frankly eschews the deeper aspects of fibre structure—wisely, we think, for such excursions as he makes into the unknown are not particularly well supported by the most up-to-date results—but for the purposes for which his book was written, and embodying as it does the author's experience accumulated over ten years or so, it is a sound contribution to textile literature, well written and beautifully produced.

The development follows the usual lines, starting with the microscope and its accessories, passing through the preparation, examination, photography, etc., of the specimens, and culminating with chapters on fabric-, yarn-, and fibre-analysis. There are copious illustrations. Prof. Schwarz and other enthusiasts appear to have devised a 'gadget' for every conceivable operation in textile microscopic research, however elementary, and photographed it too. Most of the illustrations, however, are from the publications of instrument makers, which makes the book at first sight look like a glorified catalogue, which it is not, by any means. In fact, it is a book eminently suited to certain needs of textile research associations, for it is neither too highbrow nor too sordidly industrial, but preserves a nice balance between the two, just as a research association should.

Short Reviews

(1) *Toads and Toad Life.* By Jean Rostand. Translated from the French by Joan Fletcher. Pp. xii+192+8 plates. (London: Methuen and Co., Ltd., 1934.) 7*s*. 6*d*. net.

(2) *Handbook of Frogs and Toads: the Frogs and Toads of the United States and Canada.* By Anna Allen Wright and Prof. A. H. Wright. (Handbooks of American Natural History, Vol. 1.) Pp. xi+231. (Ithaca, N.Y.: The Comstock Publishing Co., Ltd., 1933.) 2.50 dollars.

Two books so diverse in purpose, style and treatment it is difficult to imagine. Both are about amphibians, but whereas M. Rostand's book deals essentially with only a single animal, the common European toad, Prof. and Mrs. Wright are concerned with no fewer than 86 different species; the former is best read in slippered ease, but the other is designed essentially for the field naturalist who needs to identify the creatures he is observing. "Toads and Toad Life" gives a full account of the animal in relation to its environment; every phase of its normal life cycle is considered and its reactions are analysed and compared with those of other amphibians. But although there is much of scientific interest in the book, the manner of its presentation is unusual. It combines an astonishing *naïveté* with more than a touch of pedantry; at one moment the author is telling us that (p. 29) "The Toad is a good jumper, particularly when young. It can easily jump 6 inches (15 centimetres). It can walk quickly. Often it stops itself suddenly by using its back legs as a brake"; and at another (p. 38) "Bufotalin is a cardiac poison, very similar in its effects to digitalis. It stops the heart during systole and affects the nerves, causing paralysis". The authorities for many of the statements made in the text are mentioned by name, but no references are given; and the bibliography at the end of the book appears to have been compiled solely for the benefit of French readers.

The first of the "Handbooks of American Natural History" is vastly different; it is a simple, straightforward guide to the Anura of North America, intended for the student. It contains a brief, concise, general account of the group, a series of 'keys' for the identification of living specimens, one or more excellent photographs of nearly every species considered, together with distributional, morphological and ecological notes, and an extensive bibliography.

Einführung in die Physik der Gasentladungen. Von Prof. Dr. Rudolf Seeliger. Zweite umgearbeitete und erweiterte Auflage. Pp. xii+563+8 plates. (Leipzig: Johann Ambrosius Barth, 1934.) 46 gold marks.

The second edition of Seeliger's introduction to the physics of electrical discharges in gases, of which the first edition appeared in 1927, is bound to be of interest to all concerned with the work in this branch of science. Prof. Seeliger avoids unnecessary mathematical discussions, and, at the same time, gives the reader the feeling that he has before him adequate theoretical preparation for the proper understanding of the experiments and phenomena described.

The book is intended as an introduction to the fundamentals of discharge phenomena and does

not pretend to deal with technical applications, and the author succeeds in giving an interesting and critical survey of the subject. The survey is indeed sufficiently critical to bring considerable relief to those who have tried to follow the somewhat contradictory accounts which are to be found in different sources of information. In this connexion, footnotes are avoided, and the author condenses his special notes and criticisms into a valuable appendix, which also contains the necessary original references. Of particular excellence is the chapter on the Townsend discharge with its treatment of corona investigations, and the account of modern methods of active probe measurements in discharge tubes. The whole treatment is thoroughly up to date and can be heartily recommended.

Huxley. By E. W. MacBride. (Great Lives, No. 34.) Pp. 143. (London : Gerald Duckworth and Co., Ltd., 1934.) 2*s.* net.

THIS is not a very appreciative 'life' of Huxley. Prof. MacBride tells us that although Huxley invented the term 'biology', he was not a biologist but a necrologist "dealing with dried bones, fossils and the materials of dissection". He considers that his scientific fame must undergo some diminution, if evolution by natural selection is a bubble, based on a truism, and the bubble has burst, because he "accepted it wholeheartedly". He agrees that Huxley's definition of the agnostic position "conferred the greatest possible service to modern thought" but, on the other hand, his theory of the relation of mind to matter "if seriously taken and acted on, would destroy the whole basis of morality".

With all these criticisms of Huxley's opinions, of his methods and indeed in some respects of his superficiality (p. 92) the real greatness of the man is almost lost. Credit is indeed given him for his immense influence in spreading the light of the doctrine of evolution ; but few people who knew Huxley personally will feel that in this 'life' full justice has been done to his great power as a teacher, as a reformer of old and obsolete methods and as a desperate fighter for truth against error and superstition. But for all that, as Prof. MacBride always writes clearly and forcibly on all contentious matters, this little book will prove to be of value as it includes what is perhaps the best short statement we have read of the Lamarckian position at the present day, and also a very able counterblast to Huxley's materialism.

Darwin. By R. W. G. Hingston. (Great Lives, No. 27.) Pp. 144. (London : Gerald Duckworth and Co., Ltd., 1934.) 2*s.* net.

THERE has been so much criticism in recent years of what may be called nineteenth-century Darwinism that we are perhaps losing sight of the great revolution of thought in all branches of learning that was brought about by the "Origin of Species" and the other works of the great English naturalist. In Major Hingston's account of his life we find a full appreciation of the value of his researches and a welcome reminder of the immense value of his philosophy in the promotion of science.

Major Hingston summarises an interesting chapter on the great controversy about the doctrine of evolution in these words : "What the nineteenth century struggled hard to destroy the twentieth universally and quietly accepts, indeed, perhaps accepts too blindly. Darwinism is no longer the brand of Atheism, and Geology lives in peace with Genesis." He distinguishes Darwin the evolutionist from Darwin the natural selectionist and points out, quite justly, that there are but few naturalists now who would regard natural selection to be the whole cause of evolution ; "Yet the whole world," he adds, "has not been able to find a better explanation."

This is an excellent little book, well worth reading and indeed valuable for reference as a brief summary and chronology of the Darwin's life and work.

Wild Flowers in Literature. By Vernon Rendall. Pp. 372. (London : The Scholartis Press, 1934.) 12*s.* 6*d.* net.

ALL can share the heritage of delight which is to be obtained from wild flowers and literature, so that there will be few who will not rejoice to have an anthology which combines them both in association, especially when it comes from the pen of Mr. Vernon Rendall, who tells us that his reading to prepare it has ranged over half a century of his life.

The flowers are arranged in the anthology according to the natural orders, and the quotations come more or less in order of date interspersed with a running comment which is in itself a delight. Where all is delectable each can pick for himself, and although the pedantic may miss his favourite quotation, to have included all would have meant a perfection which in itself would be disappointing. In Nature, there is always the hope for something still more beautiful round the corner, and though we may return home today satisfied that there can be nothing more beautiful and that the quotation perfectly expresses what we have seen, it is comforting also to have the feeling that next week we may experience yet such another moment. To Nature lovers these thrills make up the real joys in life—to relive them at home with the aid of this companionable book is an added blessing for which we are grateful.

The Construction of Man's Family Tree. By Sir Arthur Keith. (The Forum Series, No. 18.) Pp. vi+54. (London : Watts and Co., 1934.) Cloth, 1*s.* net ; paper, 7*d.* net.

IN this little book, Sir Arthur Keith reviews and summarises the attempts which have been made to construct a family tree for man. He begins with Hæckel, and after restating his own position, discusses recent controversy on the position of the anthropoids.

The World in Modern Science: Matter and Quanta. By Leopold Infeld. Translated by Louis Infeld. Pp. 287. (London: Victor Gollancz, Ltd., 1934.) 5*s.* net.

"IF we ignore the mathematics of physics, is there anything that remains?" So asks Prof. Einstein in his introduction to this brilliant little work, which supplies a convincing answer to the question. The introduction states that the book is neither a treatise nor a textbook, and gives no mathematical formulæ or experimental details, but treats methodically and philosophically a restricted range of facts to enable the reader to appreciate and understand the limitless perspective and beauty of modern science. Actually the fundamental principles of physics are expounded in the simplest possible language with a wealth of apposite analogies and illustrations, so that the reader feels as if engaged in an absorbing novel. Under the chapter headings of methods of thought in physics—radiation, matter, the nuclei of atoms, matter and radiation, and modern quantum mechanics—all the main features of the picture of modern physics are presented in a co-ordinated and most up-to-date manner. The neutron and positron are treated as integral features in the exposition, and not as matter "received too late for classification". One is, as it were, taken behind the scenes, and shown with the liberal help of genealogical type diagrams how theories have arisen, the contributions which they made, and how and why their limitations have caused them to be superseded by newer ideas. The more advanced reader will appreciate especially the final chapter in which separate but co-ordinated accounts of the lines of reasoning of de Broglie, Schrödinger, Heisenberg and Dirac are described with a simplicity of style which, under the restriction of excluding mathematics, could scarcely be excelled.

Though it would perhaps be unduly optimistic to endorse the statement that no prior knowledge is demanded, Prof. Infeld's admirable survey can be recommended unreservedly to everyone interested in, engaged in, or instructing on modern theoretical physics. An unusual feature of a book of this type is the really good index. N. M. B.

Late Tudor and Early Stuart Geography, 1583–1650: a Sequel to Tudor Geography, 1485–1583. By Prof. E. G. R. Taylor. Pp. xi+322+8 plates. (London: Methuen and Co., Ltd., 1934.) 15*s.* net.

IN her previous volume, Dr. Taylor set out the background of geographical thought and nautical theory between 1485 and 1583. The present volume deals with a period in which the chief note is transition. The Hakluyts, more farseeing than most men of their age, thought of the new lands across the seas, not as sources of immediate wealth for spoliation, but as possible colonies which by the slower process of plantation and settlement might become more truly valuable. Ideas of control and planning appear in studies of economic geography, and gratitude is due to the author for the insertion of Plate VII, which shows contemporary cartoons dealing with those still vital questions, the beginning of capitalism and the traffic problem.

The latter half of the book consists of a very full bibliography, arranged under year of publication. This method illustrates the change in type from astronomical works and pilgrim literature to the increasing output of works on colonial geography and trade and agricultural improvements which characterise the end of the period. The first fifteen pages are addenda to the bibliography given in "Tudor Geography".

Students of historical geography will welcome this serious and fully documented account of a period when for the first time a large body of specifically English geographical literature made its appearance. But the book should appeal to a wider public; for Dr. Taylor's clear style, and her wide background of sources, combined with a flair for seizing on relevant and interesting detail, make the book well worth reading.

Die kosmologischen Probleme der Physik. Von Prof. Dr. Arthur Haas. Pp. vii+124. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 3.80 gold marks.

AT a time when the struggle between rival theories of the phenomenon of the recession of the nebulæ is still in progress, Prof. Haas's excellent summary of the whole position will be welcome to both experts and non-experts. Prof. Haas has divided his book into two parts. In the more popular first portion, he deals with the observational material regarding the recession phenomenon and describes the methods of determining the distances, distribution in space, and red-shifts of the spectral lines of the nebulæ. He shows how puzzling is the short time-scale permitted by the rapid rate of expansion and refers to the problem of the cosmic rays. Prof. Haas has succeeded in presenting the results of the observations objectively whilst evidently favouring the relativistic theory for accounting for them.

The second half of the book contains a short account of the work of Einstein, de Sitter, Lemaître and Eddington on the theory of expanding curved space, which will be found a useful introduction to more exhaustive expositions. A critic would find only two small points to object to, first, the statement that the de Sitter universe gives only a quadratic, and not a linear, law for the recession of distant objects, and, secondly, the fact that Milne's "kinematical" theory is presented rather as being what its author hoped at first to make it than what it has since turned out to be. A concluding chapter is devoted to Eddington's and Prof. Haas's own speculations on the connexion between the cosmical constant and the constants of atomic physics.

The Engineer and Modern Civilisation*

By SIR FRANK SMITH, K.C.B., SEC.R.S.

THE PRIME MOVER

IN examining the picture of the prime mover I shall look at it through the spectacles of the scientist, and endeavour to find out why the industrial revolution came when it did and not thousands of years before, and why Hero's steam engine of two thousand years ago was never more than a toy. The reason was not that the brains of Hero were not as good as those of James Watt or Trevithick, for whatever the claims may be of the engineer, he does not claim to have markedly improved the thinking power of the human race.

For thousands of years the engineer's prime mover consisted of nothing more than the water-wheel and the windmill. How came it that the steam engine was ever invented ?

Hero's steam engine was the forerunner of Barker's water mill, and some might even say of the steam turbine. Why did Hero's engine remain undeveloped ? The reason is, I think, that knowledge of the physics of gases and liquids and of pressure was almost non-existent in those days, and without such knowledge progress was impossible. For 2,000 years philosophers spoke of the horror that Nature had for empty space. Nature, they said, abhors a vacuum. Even Galileo, when told that a suction pump would not raise water higher than about 33 ft., appeared to think that it was due to Nature's resistance to a vacuum being limited.

It was Pascal, the mathematical physicist, who showed that a pressure exerted upon a fluid is transmitted in all directions, and it was Torricelli who discovered that the atmosphere exerted a pressure. It was almost inconceivable at the time that the air in which people moved and which appeared to impede their progress so little exerted a force the aggregate pressure of which on the human body was of the order of 15 tons. It was one of the great discoveries of the seventeenth century. To-day this discovery of Torricelli's may appear to be of slight importance, but one of the first committees which the Royal Society appointed for a scientific purpose considered Torricelli's results. Christopher Wren was a member of the committee ; Boyle was another. Boyle made a distinct contribution to the knowledge required for steam engine practice, for he proved the relationship between the pressure and volume of a constant mass of gas, in fact, he demonstrated the elastic properties of air.

In the days of Boyle the coal industry was in a bad way, as it is to-day, but the cause was different. The mines were becoming flooded with water, and man and horse-power were insufficient to cope with the trouble. The knowledge obtained by Torricelli and Boyle was used by Papin (1690) who observed that a small quantity of water made a large volume of steam, and this steam appeared to have all the elastic properties of air. I can but surmise that Papin concluded that if he condensed the steam a vacuum would be produced, and that water might thus be caused to rise to a higher level by the pressure of the air. In such a way atmospheric engines arose. Worcester's, Savery's and Newcomen's engines were all atmospheric engines. If the air had not exerted a pressure on the earth's surface, these early steam engines would not have worked. Watt's first engine was an atmospheric engine. It was only when steam was used at high pressure and allowed to do work by virtue of its elastic properties, that is by expansion, that there was departure from a simple atmospheric engine. Trevithick's engine was a high-pressure engine, and it was Trevithick, you will remember, who applied it to propel carriages on roads. To Trevithick also belongs the honour of being the first to use a steam carriage on a rail.

With such scant knowledge of the internal mechanism of gases the nineteenth century began. The scientist looking at the picture of that period sees more than 10,000 steam engines in use in England developing in all about 200,000 horse-power and many of these were used to prevent coal mines being flooded. All these steam engines, from a scientific point of view, were based on a knowledge of atmospheric pressure and the elasticity of gases. True, Carnot had already written his wonderful paper on the motive power of heat, but it received little attention.

There was practically no knowledge of the nature of heat. Indeed, until the latter part of the eighteenth century, heat was regarded as a material substance to which the name 'caloric' was given. After all, the idea was by no means absurd. The heat was supposed to fall from a high temperature to a lower one, like water falls from a high level to a lower one, and in the fall in temperature it was thought work was done. The heat was supposed never to disappear ; it was believed to be indestructible. To-day we believe that work is done electrically in a similar fashion ; the electricity falls from a high pressure to a lower pressure and in doing so work is done but the electricity is not destroyed. It is not therefore so very strange that the view that heat was a material substance should have been accepted in the early part of the nineteenth century. So far back as 1756 Dr. Black discovered latent heat. He had pondered over the slowness with which ice melts and water disappears in boiling and concluded, since the caloric put into the boiling water did not raise its temperature, that the heat was latent. James Watt, who was in close contact with Dr. Black, measured the change of volume

* From the Gustave Canet Lecture delivered before the Junior Institution of Engineers on June 28.

when water vaporised. He no doubt saw that the atmospheric engine worked best when the cylinder was hot and the condenser as cold as possible, and hence concluded that the best efficiency was obtained when the heat was introduced at a high level and rejected at the lowest possible level.

Nearly fifty years after Black's discovery of latent heat, Rumford made a great discovery. Without being able to see the minute particles of matter he concluded that they were in vibration and that this vibratory motion was heat. Heat was not a material substance; it was a mode of motion. For the first time in history, the mechanism of heat was revealed. Rumford's conclusion was vigorously attacked by the calorists, and although Davy confirmed his conclusions by experiments it was not until 1812 that he felt sure in asserting that "the immediate cause of the phenomenon of heat is motion and the laws of its communication are precisely the same as the laws of the communication of motion". There was thus an explanation of why water under reduced pressure lost heat, and therefore fell in temperature as more and more vapour was formed and removed. On evaporation, a particle of the vapour possessed more energy due to its motion than a particle of the liquid at the same temperature and of the same mass. Hence the water cooled. It was known even before the nature of heat was understood that ultimately the water in such circumstances would freeze. To-day, many of our large refrigerating machines operate on this simple principle.

The greatest engineering discovery of the nineteenth century was made, however, by Joule and others. The discovery was that heat and work are mutually convertible at a fixed rate of exchange: the law which is known to engineers as the first law of thermodynamics. The new idea was that the vibratory motion of the minute particles of matter which we call heat were integrated through an appropriate medium into a larger single motion, say, that of a fly-wheel, and thus a means of doing work was provided. The old idea that heat was indestructible was completely overthrown. Steam engines were then in existence, and it was realised that when work was done by a steam engine heat passed out of existence. If, on the other hand, work was done to produce heat a definite quantity of heat came into existence for each unit of work expended. It is difficult to realise that this principle of conversion of heat into work was unrecognised in the early days of Lord Kelvin, whom many here, including myself, knew quite well. The discovery was not only of the greatest importance to engineers; it was, I believe, the greatest generalisation in physics of the nineteenth century. Engineering could not have developed in the way it has had this fact never been discovered. Moreover, work was to be interpreted in the broadest sense whether done mechanically, electrically or by chemical combination. The engineer could at last visualise what happened to steam when its temperature was raised and its volume was kept constant. Increase of temperature meant increased vibratory motion of the particles which bombarded the walls of the enclosing chamber in a way that Pascal could not have dreamt of. Thus the pressure of the steam was increased. If the steam were allowed to expand, the energy of motion and the pressure fell. Work had been done and some heat had disappeared.

The new doctrine met with a good deal of opposition. A doubting scientist remarked to Mayer that if the theory were correct water would be warmed by shaking. Several weeks later Mayer proved that it was. A somewhat similar story is told by Lord Kelvin who met Joule carrying a thermometer near Chamonix. Joule told him that he wished to demonstrate that at a waterfall there was a rise in temperature due to the work done on the water itself.

It is in this way that the scientist sees the birth of the prime mover. To-day the knowledge of the internal mechanism of gases is fairly complete, the nature of heat is known and Carnot's cycle of operations is fully appreciated. All that is necessary to convert heat into work or work into heat is a suitable medium. Steam was the first medium chosen, flame or the heated products of combustion has also been chosen, mercury has been experimented with, and ammonia and sulphur dioxide are used for special purposes. In all cases the medium is in motion and it is the total heat, or total internal energy of the medium which changes during the working cycle.

In the same way as the first steam engine was an atmospheric one, that is, it worked by virtue of atmospheric pressure, so the first 'gas' engines were atmospheric. The Rev. W. Cecil produced the first in 1820; it was "an engine which is moved by the pressure of the atmosphere upon a vacuum caused by explosions". Later, Samuel Brown made engines for commercial purposes in which there was produced a partial vacuum by flame with subsequent extinction of the flame by a jet of water. It is of interest to note that Brown applied his engine to pump water, to propel a carriage and to propel a small paddle boat. There was, however, no internal combustion engine in the modern sense until some years after Joule (1843) had made his famous experiments. It was then apparent that the energy of chemical decomposition and combustion which takes place on an explosion could be converted into work, and that a definite relationship existed between the chemical energy and the work it was possible to produce.

The story I have told will, I know, appear far too simple to many to explain why the industrial revolution started when it did, and not a thousand years before. It may be that the engineer with that wonderful intuition of which we are all aware would have developed the steam engine without any knowledge of the properties of gases and with no knowledge of what heat is and what happens when chemical combination takes place. But the progress would have been very slow and,

I fear, the efficiency of the engines would have been low. There is little doubt that the early engineers sought scientific knowledge on gases and utilised it in their designs, and there is even less doubt that in modern designs the thermodynamical expert and the designer are either the one and same person or are in intimate contact. In that great engineer, Sir Charles Parsons, we had the combination of the two. The defects of the steam reciprocating engine were clear to him, and he applied all his inventive genius to bring his turbine nearer and nearer to one working in Carnot's cycle than which none can be more efficient. Parsons triumphed because he was not only a great engineer but also a great physicist. He knew thermodynamics better than most physicists of his generation, and the result of beautiful design in closest accord with thermodynamical principles can be seen in the great steam turbines in our electrical generating stations.

Let us consider the effect of the discovery of the prime mover. In the early part of the nineteenth-century Stuart, in his "Anecdotes of the Steam Engine", opened his introduction with the following lines:

"Some years ago the ten thousand steam engines which then were reckoned to be in Great Britain were estimated to perform daily the labour of more than two hundred thousand horses, equal to the power of twelve hundred thousand men expending their energy to the greatest mechanical advantage. But as machines require neither rest nor relaxation and can operate without impairing their power during those portions of time usually assigned for a cessation of animal labour, these ten thousand engines could develop from sunrise to sunrise a power superior to that of four and a half millions of labourers; an effect greater than the entire manual labour of England."

To-day in factories, industrial undertakings and electricity supply undertakings in Great Britain, steam reciprocating engines and steam turbines develop more than 20 million horse-power, equivalent to 450 millions of Stuart's labouring men. On such a basis every man, woman and child in this country has on an average ten slaves working for him in the factory and supply stations in the form of steam power. This power turns the machines in our factories for producing manufactured goods, operates generators for the supply of electric light, heat and power, sweeps many of our floors, carries us up in lifts, causes great pumps to force water to our cities, and operates numerous other mechanisms, including those for which the steam engine was first invented, namely, pumps for freeing the mines of water. In addition to these 20 millions of steam horse-power, probably another 20 millions are produced on the railways for the transportation of people and goods and we must add to this total the power of internal combustion engines, of which there were none in Stuart's time. To-day the rated horse-power of private motor-cars is above 15 millions, and that for motor lorries is above 12 millions. For motor vehicles alone there is therefore a total of 27 millions rated horse-power.

How many mechanical slaves in all the people of Great Britain have at their command it is very difficult to say. In the United States an estimate has been made that every individual there has an average of 900 of such slaves, and this is on a much more moderate basis than that of Stuart's, the new basis being that 1 horse-power is equivalent to the power of 10 men. In Great Britain we are no doubt more modest in our demands, but it is, I think, obvious to all that the harnessing of coal and oil in the service of man is easily the greatest contribution of the engineer or anyone else to our materialistic progress.

This story of the prime mover is, of course, a totally inadequate account. Many of the men I have talked about are not even classified as engineers, while some of the really great engineers like Boulton, Stephenson, Otto and Daimler have not even been mentioned. I must express my apologies. In excuse, I can but say that the work of these great men is very well known, and that I could not adequately deal with the work of one of them in the course of a single address. I hasten to say that my admiration of the inventive genius of these and others is unbounded and though to-day the solutions of the troubles they overcame may appear to be small, it is as Milton said:

"Th' invention all admired and each how he
To be th' inventor missed; so easily it seemed
Once found which yet unfound most would have
thought impossible."

As some form of compensation I propose to sound a note of praise about the latest large power station which the engineer has erected. I refer to the Battersea Power Station, which is one of the bright spots in our industrial England, inasmuch as coal is burned and power produced practically without smoke.

In the olden days the engineer burnt his fuel to raise steam, and by pouring out huge volumes of smoke and otherwise polluting the atmosphere, he showed little regard for the feeling of his neighbours. There are many such to-day, indeed far too many; but the more modern engineer is aware of the harmful effects of atmospheric pollution and is trying to abolish them. Experiments show that this veil of pollution in our atmosphere curtails the ultra-violet light from the sun by as much as 50–75 per cent, and this deprives our bodies of their proper share of sunlight. This air sewage, as it has been aptly called, damages vegetation and destroys our buildings, and it is believed that there is correlation between the sulphur compounds in it and the health of the people.

So if I were now asked where the application of science to engineering has reached its highest stage of development, I should instance the Battersea Power Station. Perhaps I am prejudiced.

I have this evening in a humble way been endeavouring to pay tribute to Rumford and Joule and other great scientists. The Battersea Power Station pays tribute to Faraday in a manner which justifies me in regarding the modern engineer as one who fully appreciates the work of his brother engineer who concerns himself with the minute electrical machines of Nature which the eye cannot even see.

This is a copy of the inscription on the Foundation Stone of the Station:

THE LONDON POWER COMPANY, LIMITED
ON ST. GEORGE'S DAY
IN THE YEAR OF THE CENTENARY OF MICHAEL FARADAY'S
GREAT DISCOVERY
THIS STONE OF COMMEMORATION
UNVEILED AT A MOMENT ABOUT NOON AND BY A
WIRELESS MESSAGE FROM OTTAWA BY
HIS EXCELLENCY THE GOVERNOR-GENERAL OF CANADA
THE RIGHT HONOURABLE THE EARL OF BESSBOROUGH,
G.C.M.G.
A FORMER DIRECTOR OF THE COMPANY
WAS PLACED AS A LANDMARK IN THE DEVELOPMENT OF
LARGER LONDON'S LIGHT AND POWER
AND TO SERVE AS ANOTHER MEMORIAL
OF THE SCIENTIFIC HERITAGE DERIVED
FROM FAMOUS ENGLISHMEN
BATTERSEA POWER STATION 23RD APRIL 1931.

In the engine room, which looks like the nave of a modern cathedral, there are at present two steam turbines with an output of 120,000 kilowatts and soon there will be a third, making a total output of 220,000 kilowatts or nearly 300,000 horse power. When I visited the Station I saw very few engineers and technicians. There was only one in the main engine-room, and he wore a spotless white coat. The 100 tons of coal which the furnaces consume every hour had never once been man-handled from the moment the mechanical grabs lifted 5 tons of it at a time from the ships alongside the wharves, until the time at which the remnants were finally removed as ash. The stoker aisle, as long as an average street, was absolutely deserted. The toiling, half-naked stoker, shovelling coal into white-hot furnaces, has no place at Battersea. Instead I saw one man controlling the six furnaces in action from a desk panel in accordance with instructions from the combustion engineers' office high up in the building. In that office the pressure, temperature and everything it is necessary to know about the steam-generating plant can be obtained from distant recording instruments and recorders by the twist of a knob. In this way, two or three men control the firing and generation of steam raising equipment, each of the six units of which generates a quarter of a million pounds of steam an hour at a pressure of 650 lbs. per square inch. What goes out of the chimneys is steam and not smoke; it is the steam of the water used in cleaning the smoke in the flues. The gases from the furnaces are driven by fans into washers in which they are sprayed with water so that 20 per cent of the sulphur is removed. They then pass into the scrubbers proper which are arranged in the main flue between the two chimneys where, by the action of moist iron filings, a further 70–75 per cent of the sulphur is removed. Further on, the gases are treated with an alkaline solution and finally passed through moisture eliminators. The wash water used to purify the gases passes away through aerating tanks and filter beds outside the Station for purification before return to the river. With its three great steam turbines the horse power available will be greater than that of the 10,000 steam engines which were reckoned to be in Great Britain at the beginning of last century, a power superior according to Stuart to that of four and a half millions of labourers.

Here, indeed, is a fine example of the engineer's service to man.

(To be continued.)

The Museum of Practical Geology

IN his report for the year 1933*, the Director of the Geological Survey and Museum of Practical Geology has included a short history of the Museum from its inception to the present day. The occasion was appropriate, for at the end of that year the Museum finally closed its door to the public, thereby placing one more milestone on the road of development of a characteristically British institution.

The prime cause of the Museum's foundation was the private geological mapping undertaken by De la Beche in Cornwall and Devon by arrangement with the Board of Ordnance. Four sheets of the Devon 1-in. map, geologically coloured, were published in 1834. In 1835 the Board of Ordnance decided to establish a department to deal with the geological colouring of its maps. It was known as the Ordnance Geological Survey, De la Beche was put in charge, and the Treasury allotted £300 a year for its upkeep. By this time, however, so much material had been collected by De la Beche that he was compelled to ask for suitable housing for it, and in 1837, Woods and Forests provided accommodation in a house in Craig's Court, Charing Cross; by 1839 the collections were in a fair state of order. In the same year a small laboratory was installed for the analysis of rocks, minerals and soils, with R. Phillips, the curator, as chemist. In 1838, T. Sopwith, with the support of De la Beche, had read a paper before the Newcastle meeting of the British Association, on the need for the conservation of mining records; this, the Association backed by a resolution which

* Report of the Geological Survey of Great Britain and the Museum of Practical Geology (Summary of Progress) for the Year 1933, Part 1. H.M. Stationery Office. Price 1*s*. 6*d*. net.

resulted in the establishment of the Mining Record Office at Craig's Court.

De la Beche's great conception of an organisation uniting with the Geological Survey, the Museum of Economic Geology (as it was then called), and the Mining Record Office, a School of Mines having teaching equipment to cover, besides mining and metallurgy, all the related sciences required for a knowledge of mineral products and their uses, was impossible of realisation at Craig's Court. Consequently, he agitated for more suitable accommodation and, the time being ripe, he met with rapid success; the new Museum in Jermyn Street was commenced in 1848 and opened by the Prince Consort on May 12, 1851, as the "Museum of Practical Geology, Government School of Mines and Science applied to the Arts".

Within the limitations set by the confined space and the complex functions of the new building, Pennethorne's design must be regarded as successful. Yet from the beginning, its scale was too small for its duties; room had to be found in a small house on the west side of the new building for the Geological Survey staff and Mining Record Office; while on the east side, another house was occupied in part by the metallurgical laboratory.

It was here that De la Beche, 'President' of the new school, with the small but brilliant staff he had assembled, laid the foundations of what are to-day the Imperial College of Science and Technology and the Royal School of Mines at South Kensington. The first professors were, Lyon Playfair (chemistry); Edward Forbes (natural history applied to geology and the arts); T. Hunt (mechanical science, including some physics); J. Percy (metallurgy); Andrew C. Ramsay (geology); Warrington W. Smyth (mining and mineralogy). Hunt was also keeper of mining records, and Trenham Reeks was registrar of the School and curator of the Museum.

In 1853 there was some expansion of the scope of the School and its title became the "Metropolitan School of Science applied to Mining and the Arts"; then in 1859 the courses for the associateship were restricted to mining and metallurgy, with geology, and the title of the School reverted to the original one. In 1863 the School became the Royal School of Mines.

From the commencement, instruction had been given mainly by lectures, though practical work was done in metallurgy, chemistry and geology under restricted conditions. The demand for more laboratory teaching grew, with the result that the Departments of Chemistry, Physics and Biology were transferred to South Kensington, in what is now the Huxley Building; Geology, Metallurgy, Mining and Applied Mechanics followed later, but Percy clung to his old laboratory until 1880.

Besides being used for most of the School lectures, the theatre, capable of seating about six hundred, was employed for a series of evening "Lectures to Working Men". These were delivered mostly by professors of the School, but included also some of the foremost scientific workers of the day. Every effort was made to limit admission to *bona fide* working men, but the lectures became so popular that there was keen competition for tickets from persons of all classes. After the transfer of some of the departments, the public lectures ceased to be given at Jermyn Street, but until the close of the last century, the theatre was in demand for the meetings of scientific societies; its demolition then permitted a much needed expansion for the exhibition and storage of specimens and models.

The duty of the Museum was, in the first place, to be the depository for material collected by the Geological Survey and for its display, along with the geological maps and models; but in order to function as a museum of practical geology, its field had to embrace all useful mineral substances. The exhibits of rocks and fossils were limited to those of the United Kingdom and were arranged in stratigraphical order; the minerals included specimens from all parts of the world and these were arranged in groups according to their bases and topographically, by far the most convenient system for public use. Along with the ores of metals were exhibits illustrating the mode of extraction and metallurgy, with examples of manufactured products.

The rapid growth of industrial application of the sciences soon made it impossible to keep pace with progress in the arts. The metallurgical exhibits ceased to be developed for lack of room, though the fine collection of porcelain and pottery had been allowed to expand to dimensions quite out of proportion to the rest of the scheme. Eventually these technological exhibits were dispersed to other museums, and the Jermyn Street display during the past thirty years has been confined to the practical aspects of geology and mineralogy.

From time to time various proposals had been made for the reorganisation of the Survey and Museum, but no decision was taken until the Museums Commission met in 1927; acting upon the Commission's recommendation, the Government agreed to the transfer to the site in Exhibition Road, proposed by the Bell Committee's Report of 1912, and the new building for the Museum of Practical Geology and offices of the Geological Survey was put in hand and completed by H.M. Office of Works in 1933. This spacious building will afford the long-desired opportunity to arrange an exhibition on modern and more popular lines and with greater facilities for use as an educational instrument. Here De la Beche's ideal will attain its consummation, to the mutual advantage of all the related institutions at South Kensington.

The arduous work of removal and re-arrangement of the collections is in progress, and it is intended to synchronise the centenary celebration of the birth of the Geological Survey with the opening of the new museum in 1935.

Obituary

Dr. N. L. Britton

The death on June 19 of Dr. Nathaniel Lord Britton, for many years director-in-chief of the New York Botanical Garden, removes one of the most prominent figures in North American botany. Born on January 15, 1859, Britton took the degree of E.M. at Columbia University in 1879, proceeding to Ph.D. in 1881. It will come as a surprise to many who knew his work that the first nine years of his professional career (1879–87) were spent as assistant in geology at Columbia University, and that fourteen of his early papers published during the period 1882–89 dealt with geological subjects. His heart even then, however, was in botany, as is shown by the list of twenty-nine botanical papers covering the period 1878–87. From 1880 until 1890, Britton was botanist and assistant geologist to the New Jersey Geological Survey. His appointment as instructor in botany at Columbia University in 1887, followed by promotion to adjunct professor in 1890 and professor (1891–96), coincided with a great increase in his botanical output.

Among Britton's more important publications during the period 1888–96 was a series of papers on "New or noteworthy North American Phanerogams" and "An Enumeration of the Plants collected by Dr. H. H. Rusby in South America". About the year 1888, Britton became interested in botanical nomenclature, which was then becoming a subject of keen controversy. He was always a rigid adherent of the principle of 'priority of publication' and rejected the arguments based on 'convenience' which eventually led to the acceptance, by successive International Botanical Congresses, of the principle of conservation of well-known generic names. His nomenclatural views led to the publication of numerous name-changes such as those in the "Preliminary Catalogue of Anthophyta and Pteridophyta reported as growing spontaneously within 100 miles of New York City" (1888). These divergences in nomenclatural views between two different groups of botanists in the United States culminated in the rejection, by one of these groups, of the International Rules of Nomenclature (1905) and the formulation of a rival set of rules entitled "American Code of Botanical Nomenclature" (*Bull. Torr. Bot. Club*, 34, 167; 1907). It is now hoped that the changes introduced by means of friendly agreement into the third edition of the International Rules (now in the press) will make them acceptable to the vast majority of botanists. It is pleasant to record that though Britton seems to have retained his nomenclatural views unaltered until the end, he never allowed them to interfere with the cordial relations subsisting between the New York Botanical Garden and other institutions.

The third period of Britton's career was as director-in-chief of the New York Botanical Garden (1896–1929). Among the more important floras prepared by him are the "Illustrated Flora of the Northern United States, etc." (1896–98; second edition, 1913), "Manual of the Flora of the Northern States and Canada" (1901; third edition, 1907), "American Trees" (1908), "Flora of Bermuda" (1918), "Bahama Flora" (1920, with C. F. Millspaugh), and "Botany of Porto Rico and the Virgin Islands" (1923—, with P. Wilson). The lavishly illustrated monograph, "The Cactaceæ" (4 volumes, 1919–23), written in collaboration with the late Dr. J. N. Rose, was one of his most important pieces of taxonomic research. In connexion with the preparation of these works, Britton travelled extensively in the West Indies and elsewhere.

Britton also acted as editor of the *Bulletin of the Torrey Botanical Club* (1888–97) and as joint editor of the "North American Flora" (1905—). The new periodical *Brittonia* (1931—), issued by the New York Botanical Garden, was named in Britton's honour after his retirement from official duties.

On his retirement from Columbia University he was made emeritus professor and, among his many honours, he was elected a foreign member of the Linnean Society of London in 1925.

Dr. Britton lost his wife, Mrs. Elizabeth Gertrude Britton, on February 25 of this year, and her death must have been a great shock to him as they were very devoted to each other. Like her husband, she was a keen botanist and made a special study of the mosses her life work. She was one of the prime movers in organising the Wild Flower Preservation Society of America, and was also one of the principal members of the Torrey Botanical Club which promoted the establishment of the New York Botanical Garden, of which, after its incorporation in 1891, Dr. Britton became director-in-chief in 1896. Her valuable volunteer services in the care of the Moss Collection was recognised in 1912 by her official appointment as honorary curator of the mosses in the herbarium of the New York Botanical Garden.

T. A. Sprague.

We regret to announce the following deaths:

Father Giuseppe Gianfranceschi, president of the Pontifical Academy of Sciences and director of the Vatican Broadcasting Station, on July 9, aged fifty-nine years.

Mr. H. O. Larsen, one of the founders of the Experimental and Research Station, Cheshunt, Herts, and a leading horticulturist, on July 3, aged sixty-four years.

Dr. Marion Newbigin, editor of the *Scottish Geographical Magazine* and author of numerous geographical works, on July 20.

Dr. Jakob J. Sederholm, director of the Geological Survey of Finland, on June 27, aged seventy-one years.

News and Views

Prof. H. S. Carslaw

PROF. HORATIO SCOTT CARSLAW, whose approaching retirement from the chair of mathematics, pure and applied, at the University of Sydney has just been announced, was appointed to that post some thirty-two years ago. Born in 1870, he is a son of the late Rev. W. H. Carslaw, D.D., of Helensburgh, a well-known writer on the martyrology of the Scottish Reformation and of the Covenants. After graduating at Glasgow, Carslaw proceeded to Cambridge, where, among other distinctions, he gained a Smith's prize and was elected to a fellowship at Emmanuel College. Prof. Carslaw has always taken advantage of the sabbatical years granted periodically by the University of Sydney to renew his connexion with his old college. On the last of these occasions Emmanuel College showed its appreciation of his eminence as a mathematician by re-electing him to a fellowship. The University of Glasgow, in which, before going to Australia, he served for five years as senior lecturer in mathematics, also took this opportunity of conferring on him the honorary degree of LL.D. Prof. Carslaw has been a prolific writer of mathematical papers and textbooks. His "Fourier's Series and Integrals", published in 1906, is regarded as a standard work. In later and amplified editions, this book has been divided, the part dealing with applications to the "Conduction of Heat" appearing as a separate treatise. In 1912 Carslaw published a translation of Bonola's "Non-Euclidean Geometry", and in 1916 he produced a textbook of his own on the same subject. Other writings include "An Introduction to the Infinitesimal Calculus" and a "Plane Trigonometry". To Prof. Carslaw increased leisure means opportunity for further researches ; the fruits of these activities are awaited with interest by his many friends.

Aberdeen Meeting of the British Association

THE local honorary secretaries for the Aberdeen meeting of the British Association, which will be held on September 5–12, refer in our correspondence columns this week (p. 144) to a rumour that lodging accommodation is difficult to obtain in Aberdeen during the week of the meeting. The explanation of that rumour probably is that in the preliminary programme of the meeting it was intimated (as usual) that members wishing for hotel accommodation might find it more convenient to apply direct to hotels (of which a list was given) than to ask the help of the local committee in finding accommodation. Some members, having unsuccessfully attempted the first course, may have not availed themselves of the second ; if so, they need not hesitate to do this. Of all the duties which the Association imposes upon its voluntary helpers at the place of meeting, that of securing accommodation for visiting members is probably the most onerous, but it is always cheerfully undertaken, to the honour of the locality and to the lasting gratitude of the Association. There is not the slightest reason to fear that Aberdeen will fail to sustain the one, or to merit the other.

New Arctic Expedition

A BRITISH expedition to Ellesmere Land left London on July 17 in the Norwegian sealer *Signalhorn* under the leadership of Dr. Noel Humphreys. Other members include the organiser, Mr. E. Shackleton, Mr. A. W. Moore, Mr. R. Bentham and Mr. D. Haig-Thomas. A sergeant of the Canadian Police, with wide experience of the Arctic, will also join the expedition. At Disko in Greenland, 70 dogs will be taken on board, and thence the ship will sail to Thule to embark two Eskimo families. It is hoped to pass north along Smith Sound as far as Fort Conger, the site of the Greely expedition of 1882–83 in Lady Franklin Bay at the north end of Kennedy Channel. Ice may prevent this, in which case winter quarters will be set up at Bache Peninsula further south. During the autumn, depots will be laid out as far north as possible in Grant Land, the northern end of Ellesmere Land. The ship will not winter. The main area of exploration will be the little-explored Grant Land of which the coasts are known chiefly from the work of Nares and Peary and a little of the interior from MacMillan's works in 1924. The geological discoveries promise to be of special interest in relation to the probable extension of Caledonian foldings in that area. The expedition hopes to return in the summer of 1935.

A New American Ascent into the Stratosphere

NEWS has been received through Science Service, Washington, D.C., that arrangements for a new observation balloon ascent into the stratosphere are well advanced. This new attempt is being organised jointly by the National Geographic Society and the U.S. Army Air Corps. The pilot will be Major W. E. Kepner, who holds a long and distinguished record as aeroplane pilot and racing balloonist, whilst the observer will be Capt. A. W. Stevens, who is also an expert in long-range photography. A strong motive for the new flight is the breaking of the altitude record of 50 m.m. (62,000 ft.) held at present by *Stratostat USSR* made last year and the higher-claimed Russian flight of January this year, which ended disastrously. Generally, however, from the nature of the equipment included, which is said to weigh a ton, the aims of the projected flight are to investigate cosmic radiation with particular reference to the Steinke bursts. The instruments include spectrographs, air samplers and special cameras the records of which, if the weather is clear, will give heights by triangulation, wind direction and velocity. Barometers will be checked for height, and the influence of height on radio-transmission will be studied. The lessons of the past have been learnt. To safeguard the crew, a pneumatically controlled hydrogen release valve can be operated from the gondola, and in case of necessity the gondola can be

brought to the ground by parachute. The crew have personal parachutes and exit portholes. The balloon itself is three times as large as any previously built. It will contain 3 million cubic feet of hydrogen which will fill it to one tenth of its capacity on the ground. The flight is intended to be of twelve hours' duration, the take off being from a hollow in Black Hills near Rapid City, S.D., when the wind conditions are from the north-west.

Museum of Science and Industry at Newcastle-upon-Tyne

A NOTABLE event for Tyneside, and indeed for the north of England generally, was the opening at Newcastle-upon-Tyne on July 20 of the Municipal Museum of Science and Industry. The ceremony was performed by Mr. R. J. Walker, President of the North East Coast Institution of Engineers and Shipbuilders, which has helped the scheme materially. The gift was accepted on behalf of the citizens by the Lord Mayor of Newcastle, Councillor J. Leadbitter. An institution to record and illustrate the many-sided scientific and industrial advances made in this district had long been talked of, but it was the exhibition held at Newcastle in 1929 which gave impetus to the effort which has culminated in the present Museum. It is housed in a building on the Town Moor, formerly part of that exhibition, and refitted for its present purpose by the Town Moor and Parks Committee of the Corporation. The task of collecting and arranging objects has been in the capable hands of Capt. E. W. Swan, acting with the above Committee. The aim of the Museum is to illustrate development, like the Science Museum, South Kensington, and its scope is similar, but restricted. Excellent progress has been made, in shipbuilding and electricity especially, as might be expected, but a great deal is still to be done. However, with the evident enthusiasm, the material available, more adequate funds, and willing helpers, the task should not be too heavy, and we wish the new Museum every success.

Progress in Materia Medica

IN few provinces is it more difficult to define the direction of progress than in the province of materia medica. To eat your enemy's heart that you may add his courage to your own seems a relapse into a barbarism centuries old. Yet medicine has but recently rediscovered that raw liver or the scrapings of the stomach of the pig have a virtue in remedying deficiencies of those organs in man. In 1820, Paris ascribed "the revolutions and vicissitudes which remedies have undergone" to, among other causes, "Superstition, Credulity, Devotion to Established Routine, the assigning to peculiar substances Properties deduced from Experiments made on Inferior Animals, Ambiguity of Nomenclature, the application and misapplication of Chemical Philosophy". As Mr. C. H. Hampshire pointed out in his chairman's address to the British Pharmaceutical Conference at Leeds on July 17, "drugs are introduced on high authority and supported by expressions of clinical confidence, they flourish for a time and then sink into a position of relative unimportance and finally pass almost completely out of use". There is, nevertheless, a point on the circle which represents the best scientific and medical practice of the day, a point which Mr. Hampshire fairly infers to be represented by the "British Pharmacopœia, 1932", a fact which justifies use of that book as a criterion for determining the extent to which the pharmacopœias of other countries reflect what is best in modern medical and pharmaceutical practice.

Modern Pharmacopœias

APPLYING the yardstick of the British Pharmacopœia to its contemporaries, he finds the Spanish Pharmacopœia of 1930 one of the most satisfying and instructive of the modern pharmacopœias, although still retaining some aroma of the past by the inclusion of castoreum and musk. The Swiss Pharmacopœia of 1933 is an excellent production pharmaceutically, although omitting modern methods of biological testing, through the absence of a public laboratory for performing these tests in Switzerland, comparable with that of the Pharmaceutical Society in Great Britain. The utility of the Yugoslavian Pharmacopœia, 1934, is limited by its being printed in Slavonian, a difficulty which the Hungarian Pharmacopœia, 1934, overcomes by the use of Latin, the scientific *lingua franca* of two hundred years ago and still current, though in a bastard form, where physicians and pharmacists work together. The language problem is one only of those disclosed by an examination of eight of the most modern of the European pharmacopœias, and the conclusion to which Mr. Hampshire is drawn is that the steps taken by International Conferences in 1902 and 1925 towards the international unification of the formulæ of potent medicaments should be actively followed up, a proposal which the innocent abroad with his prescription will endorse. His further proposal that there should be a permanent body charged with this duty is probably less likely to be welcomed by a generation grown sceptical of the activities of international committees and disinclined to put its hand in its pocket for the maintenance of yet another.

Future Changes in Medical Practice

IN addressing the graduates in medicine at the graduation ceremonial at the University of Edinburgh on July 18, Prof. A. J. Clark pointed out that to-day the prevention of disease, or its cure at an early stage, is becoming the chief function of the doctor. It is more interesting to try to enable the human machine to work with full efficiency than to patch up human wreckage so that it can just continue to function, but undoubtedly the diagnosis and treatment of slight deviations from the normal present problems of exceptional difficulty. Another point worthy of notice when considering their future careers, is that the demands of the public will be further modified by inevitable changes in the composition of the population. The figures for the birth rates during the last few years show that the average size of the family in the near future will be nearer

two children than three. At first sight, it might appear that this diminution in the number of children will seriously curtail an important section of medical practice—obstetrics and the care of children. But the fewer the children, the more precious will they be, and though childbirth will be less common it will require more skilled assistance, hence these changes will not cause a proportionate decrease in the demands on the medical profession. The steady increase in the number of persons over sixty-five years of age, that has commenced already, is bound to have a very marked effect on medical practice, for the human body, though a marvellous machine, is not immune to the wear and tear of life and hence requires increasing attention in old age. One outstanding change in medical practice in the future is likely to be a rapidly increasing demand for skilled assistance to combat the minor disabilities of old age.

X-Ray Equipment at the Sheffield Radium Centre

AN event of considerable interest was the opening by H.R.H. the Duchess of York on July 5 of the new Sheffield Radium Centre. It may be mentioned that the Royal Infirmary has been a National Radium Centre for some years. A noteworthy feature of the installation is a new deep X-ray therapy set which has been supplied by the Research Department of the Metropolitan-Vickers Electrical Co., Ltd., and the installation is unique. The equipment comprises two X-ray tubes and the necessary associated apparatus, operating at 200,000 volts. The arrangement is such that it is possible to treat two patients simultaneously, but the apparatus is designed so that this is done with a minimum of complications. The Metropolitan-Vickers Electrical Company's high-voltage X-ray tube for deep therapy treatment has only been rendered possible by the production in the Company's research laboratories of a range of low vapour pressure oils for use as working fluids in condensation pumps, thus enabling the highest vacua to be attained without the use of liquid air or other cooling media. These pumps had already been applied to evacuate dismountable valves, and a considerable amount of experience had been gained on their operation under commercial service conditions. The X-ray tubes possess two great advantages ; these are the ease with which filaments, targets, etc., can be replaced, the costly tube renewals necessary in a sealed-off apparatus being eliminated, and the fact that, once the tube has been conditioned, no great care need be taken in the application of the high voltage.

THE X-ray tube itself is of a robust design, and is continuously rated at 200 kV. D.C., 10 milliamperes. Adequate safety factors are provided ; for example, the external spark-over voltage is about 300 kV., while that for the internal parts is much higher. The target is at earth potential, and it thus becomes possible to cool it with water from the ordinary high-pressure mains ; experimental work has shown that a power of 6 kW. may be dissipated in 1 sq. cm. of a gold target cooled in this way. The whole equipment—X-ray tube, rectifiers and pumps—is completely automatic ; in all cases, the operation of a simple press switch starts a pumping sequence which ends, if the complete vacuum system is in normal operating conditions, with the switching on of the filaments. Vacuum relays are employed to control the electrical circuits in relation to the vacuum conditions, while illuminating diagrams are arranged to show continuously the state of both vacuum and electrical circuits.

Gift of Handley Page Aeroplane to the Science Museum

THE Handley Page aeroplane *Gugnunc* was presented to the Aeronautical Section of the Science Museum on July 19. On behalf of Lord Londonderry, Sir Christopher Bullock, in presenting the aeroplane, said that this machine marks a very distinct period in aviation, namely, the point at which safety in the air became one of the prime considerations as distinct from speed and carrying capacity. Mr. Handley Page's *Gugnunc* was built to participate in the Daniel Guggenheim International Safe Aircraft Competition held in the United States in 1929. Sir John Siddeley also presented the 150 horse-power Siddeley *Mongoose* air-cooled radial engine which is fitted in the *Gugnunc*. The aeroplane embodies the principle of the Handley Page slot which has been one of the most valuable contributions of British designers towards the security and safety of those who travel by air. The great enemy of the pilot, particularly in large machines, has been the 'stall', that is to say, there is a point at which the machine may be so far tilted backwards that it loses its power of lift and falls, sometimes uncontrollably, towards the earth. The great benefit derived from Mr. Handley Page's slot is that it enables the machine to fly at a much lower speed than normal before this danger point is reached. In fact, even after the machine has stalled, the pilot can retain control, and he does not fall into a dangerous dive or spin, but the machine sinks on a level keel. The slot has been adopted for the very large majority of aircraft used in the Royal Air Force as well as for private and commercial aircraft. In addition, 34 other countries use the device on military and civil aircraft. The designers have not yet exhausted the possibilities of the principle which is embodied in the Handley Page slot, and the technical staff both at the Handley Page works and at the Air Ministry have for a long time been engaged on research into the various possibilities arising out of this principle. The other two full-size machines in the Section are Wilbur Wright's machine, in which the first flights were made, and Alcock and Brown's *Vimy* which flew the Atlantic.

Water Supplies and the Drought

IN an article on "Water Supplies and the Drought" in the *Quarterly Review* of July, it is stated that the severe drought has found most urban water undertakings in a sound condition, with reasonable provision for emergencies. They should, however, thoroughly review their position in the light of recent experience, though they should be careful to avoid

the wastes of panic expenditure. Complete reserves for very exceptional droughts are unnecessary so long as they are adequate for other emergencies and plans are prepared for surmounting the difficulties of exceptional drought. Long views must be cultivated, since large water schemes take years to carry out. Where neighbouring areas have common interests, needs can best be met and expenditure saved by the formation of regional committees. Since water is so much a matter of local provision, and it is so important for democratic government to avoid excessive centralisation, water authorities must shed their parochialism and work out regional policies which, when dovetailed, will provide a national policy of the best sort, namely one fashioned from the needs of the areas which have to be served. If they do not co-operate in this way, compulsion may have to be applied. For rural supplies, help must be, and has been, provided. But rural consumers must pay their fair proportion towards the cost. If all parties do their share, the back of the rural problem can be broken with the million of money made available by the Government.

Bacteriological Examination of Water

IN a report recently issued by the Ministry of Health, a routine procedure is described for the bacteriological examination of water supplies (Reports on Public Health and Medical Subjects, No. 71. London: H.M. Stationery Office. 9*d*. net). Hitherto, almost every laboratory has employed its own technique, so that reports by different analysts on the same samples of water may show considerable variation and discrepancies. In a quantitative procedure like water analysis, it is especially important that all workers should employ the same methods, otherwise results, and the interpretation thereof, must vary from one laboratory to another. The procedure described in the present report, drawn up by an influential committee which included the late Sir Alexander Houston, if generally adopted, should go far to ensure more uniformity than formerly. The Committee, while describing in detail the general procedures, allows considerable latitude for the determination of the various indexes of excretal pollution. One of the principal innovations is the substitution of agar for gelatin medium for the count at 20° C., and tables are provided by which the most probable numbers of *B. coli* in 100 ml. may be determined. Standards are suggested, and precise details are given for the taking of samples.

Finds in the Kharga Oasis

AT the British Museum, exhibits from the Libyan Desert have been arranged at the head of the main staircase, primarily for the International Congress of Anthropological and Ethnological Sciences which is being held on July 30–Aug. 4, but the exhibition will remain open until the autumn. Under the auspices of the Royal Anthropological Institute, the expedition was conducted by Miss Caton-Thompson, the geological work being undertaken by Miss E. W. Gardner. The oasis is an area below the general level of the desert about 120 miles west of Thebes and 400 miles from the Mediterranean; and the most prolific sites on the floor of the Depression were fossil springs, which forced up sands and clays and formed mounds with the help of vegetation, such as palms and reeds. The mounds contain St. Acheul types of flint implements, with Aterian (Upper Palæolithic) after an interval. There is a general likeness to specimens from Palestine, and typical Levallois artifacts include several plunging flakes. The remarkable gloss, like porcelain, on many hand-axes is here accounted for by the friction of sand-charged water. On the scarp of the Depression Tufa deposits have yielded a number of flint implements ranging from St. Acheul to a phase preceding the Sebilian of the Nile Valley. The deposits include three species of fig, with land and freshwater shells all of living species. The rainfall can be studied from the combined evidence; and the exhibits include specimens of raw material roughly shaped, a fine series of arrow-heads from the surface, and contemporary beads of ostrich egg-shell. Finally, there is an object-lesson in patination, flints of a single culture showing at least three kinds of surface alteration.

Panama Earthquake of July 18

THE first movements of a great earthquake were recorded at Kew Observatory on July 18 at 1 h. 48 m. 29 s., G.M.T., the record indicating that the centre was at a distance of about 5,800 miles, probably in the Pacific Ocean off Ecuador. On the same day, a series of severe earthquakes occurred in the isthmus of Panama, one of which was strong enough to cause such damage in Ciudad David, in the extreme west of Panama, that it will have to be almost entirely rebuilt. No serious injury, it is said, occurred in the canal itself. From the first brief accounts, it would seem that the origin may be connected with that of the Colombia earthquake of January 31, 1906 (about 135 miles west of Esmeralda), possibly also with that of the Ecuador earthquake of last October 2 (NATURE, 132, 779, Nov. 18, 1933), though perhaps to the north or north-west of both.

National Institute of Agricultural Botany

AT the annual general meeting of fellows of the National Institute of Agricultural Botany at Cambridge on July 19, the chairman of the Council, Sir John Russell, in the course of his address stated that the year 1934 is one of the most important in the history of British agriculture for it is the year in which great schemes of organisation are being attempted. Gluts are good for no one, and it is far better to obtain supplies by definite organisation than by trusting to luck. For successful organisation, the best materials are essential, and the Institute, though not concerned with schemes for the organisation of marketing, is concerned with technical problems connected with improvement of agriculture. Its activities cover three broad fields. It helps the farmer by advising him as to the best varieties: it helps the scientific worker by telling him whether a new variety is worth marketing: and it helps the

seed trade by forming a link between the genetical laboratory and the industry. The Institute is marketing this autumn a new oat, Resistance, which has yielded 32 per cent more than Grey Winter in the Institute's 1931–2 and 1932–3 trials; but this new variety requires clean, rich soil, and early autumn or February sowing in situations which are not too exposed, if its high yielding capacity is to be fully exercised. Sugar beet is another crop on which the Institute has done valuable work. The average yield for Britain is about 8 tons per acre. Many farmers, however, obtain 12–15 tons per acre. From this, it is apparent that the average yield can be, and will be, considerably increased if farmers grow the right strain.

Beit Fellowships for Scientific Research

THE following Beit Fellowships for Scientific Research at the Imperial College of Science and Technology, during the Academic Year 1934–35, have been awarded: New Fellowships for one year, renewable for a second year, to Mr. H. I. Stonehill, of East London College, for research into the applicability of the modern theories of strong electrolytes due to Debye, La Mer, Bjerrum, Davies, etc., the experimental work taking the form of measurement of the E.M.F. of certain cells, under Prof. J. C. Philip; Mr. J. R. Tillman, of the Imperial College, for research on electron diffraction, both from the point of view of studying crystal forms and the mechanism of diffraction, under Prof. G. P. Thomson; Mr. J. Bell, of the Imperial College, 1927–34, for a spectrographic investigation of hydrocarbon combustion, under Prof. W. A. Bone. Extensions of fellowships already satisfactorily held for one year have been awarded to Dr. K. Bailey, for research on seed mucocellulose and its relation to the chemistry and hydration of the plant cell wall; Mr. M. Blackman, for research in mathematics on the several different properties of crystal lattices with particular reference to the specific heat; and Mr. S. F. Boys, for research in chemistry and particularly a review of the theoretical work on optical rotatory power.

Beit Memorial Fellowships for Medical Research

IN announcing the awards made this year of Beit Memorial Fellowships for Medical Research, the trustees state that they were influenced by a special desire to promote research in relation to mental disease. The following elections were made, the subject and place of the proposed investigation being indicated after the name: *Fourth Year Fellowships* (£500 per annum): Mr. R. Hill, to continue his research on the properties of hæmoglobin and cytochrome (Dunn Institute of Biochemistry and Molteno Institute, Cambridge); Dr. L. H. Stickland, to continue work on the metabolism of the strictly anærobic bacteria of the genus *Clostridium* (Dunn Institute of Biochemistry, University of Cambridge). *Junior Fellowships* (£400 per annum): Dr. S. Zuckerman, experimental study in animals of the neurovascular control of reproductive functions (Department of Human Anatomy, University of Oxford); Mr. H. W. Fullerton, etiology and treatment of hypochromic anæmia of women of the poor classes (Department of Medicine, University of Aberdeen, and Rowatt Research Institute, Aberdeen); Mr. E. M. Lourie, chemotherapy in protozoal disease (Liverpool School of Tropical Medicine); Mr. J. S. Mitchell, effects of radiation on thin protein films (Laboratory of Colloid Sciences, University of Cambridge); Dr. D. E. Green, effect of hormones and vitamins upon metabolism of individual organs (Institute of Biochemistry, University of Cambridge); Dr. G. A. Grant, metabolism of galactose and the physiological synthesis of lactose by the active mammary gland (Lister Institute of Preventive Medicine, London); Mr. S. L. Cowan, to continue study of the chemical exchanges occurring in crustacean nerve, as a result of stimulation and oxygen want; to study the blood flow through the kidney during diuresis (Pharmacology Laboratories, University of Cambridge); Dr. M. Jowett, metabolism of the central nervous system with reference to the effects of narcotic and basic amines in cases of mental disorder (Biochemical Laboratory, Cardiff City Mental Hospital).

Thunderstorms and Lightning

PROF. B. F. J. SCHONLAND, of the University of Cape Town, has recently given an interesting account of recent advances in our knowledge of thunderstorms (Science Service of June 19). The first noticeable point is that the quantity of electricity stored up in the average thunderstorm is surprisingly small. It is only about twenty coulombs, that is, the quantity of electricity that flows through an electric glow lamp in a minute. The thundercloud generates this quantity in five seconds, and after maintaining it at this value for some time it is forced to let it disappear as a lightning flash at a pressure of about 5,000 million volts. It is this enormous pressure that makes the discharge so spectacular and so dangerous. The thundercloud machine is continuously generating electricity at this high pressure. The author estimates that a single cloud can develop three million kilowatts of power. The motive power behind this great electrical machine is the wind, which blows up from below the cloud with tremendous force, like a gale up a chimney. It is this upward current of air which supports the cloud which may contain 300,000 tons of water, and sometimes hailstones of considerable size are suspended by it. The photographs taken of flashes in South Africa by slow-speed photography show that at first a little tongue of light stretches earthwards about 50 yards from the cloud. The light then pauses and fades out for the ten thousandth part of a second. It then reappears and stretches another 50 yards and so on until the ground is reached. Branching tongues may come from it, but the instant the leader touches the ground the main part of the stroke begins. A brilliant flame sweeps upward from the ground towards the cloud retracing the path blazed by the leader. This second stroke is much quicker, lasting only about fifty millionths of a second. The full explanation of the mechanism of this phenomenon is not yet understood.

B.D.H. Medical Products

AMONG the pamphlets recently received from the British Drug Houses, Ltd., London, N.1, is a series describing their vitamin products, Radiostol, Radiostoleum and Radio-Malt. It is pointed out that the proof that pure vitamin D (calciferol) cures human rickets has recently been furnished by the work of J. C. Spence (*Lancet*, 911, Oct. 21, 1933). This investigation forms the concluding chapter of the series, which began with the discovery of vitamin D, and includes the discovery of the effect of ultraviolet light upon ergosterol and the final isolation of the vitamin in the pure state. Another compound which has recently found a use in clinical medicine is glycine or amino-acetic acid. It is employed in large doses by the mouth in certain diseases of the muscles, since there is evidence of a disturbance of the metabolism of creatine and creatinine in these conditions, and it is now known that creatine plays an important part in muscular contraction in the form of phosphagen or creatine-phosphoric acid. Glycine B.D.H. is a white crystalline substance with a sweetish taste readily soluble in water; up to 30 gm. can be taken daily with safety. In some of these cases greater improvement is observed if ephedrine is also given.

International Congress on Alcoholism

THE twentieth International Congress on Alcoholism will be held at the Imperial Institute, South Kensington, S.W.7, under the presidency of Lord Astor on July 30–August 3, when the following papers among others will be read: "Licensing Legislation in Europe", by Dr. R. Hercod of Lausanne; "Legislation on Inebriety", by Dr. E. Gabriel of Vienna; "Alcohol Consumption and Specific Male Mortality", by Dr. R. Bandel of Nuremberg; "Alcohol in the Treatment of Disease", by Dr. J. D. Rolleston of London; "Alcohol and Eugenics", by Prof. H. Gachot of Strasbourg; "The Causes and Treatment of Inebriety", by Dr. A. E. Carver of Caldecote Hall; "The Toxicological Aspects of Alcohol and Drug Addiction", by Sir William Willcox of London; and "The Teaching of Hygiene in Schools", by Sir George Newman. The Congress will be attended by representatives of the following Governments: Austria, Denmark, Finland, France, Mexico, Poland, U.S.S.R., and Switzerland. Membership tickets, price 10*s*., can be obtained from the Secretariat, Room H, Imperial Institute, South Kensington.

Announcements

MR. W. F. HILTON has been awarded the Armourers and Brasiers' Company's research fellowship in aeronautics. Mr. Hilton will carry out his research work at the Imperial College of Science and Technology, London.

IT is announced that the library of the Geological Survey will be closed on July 23 during transfer to the new Museum at South Kensington. It is expected that it will not be reopened for two months. During the interim, members of the public who wish to consult the published Geological Survey maps and memoirs may do so at the Library of the Geological Society, Burlington House, Piccadilly, W.1.

AT the invitation of the Council of the Pharmaceutical Society of Northern Ireland, the British Pharmaceutical Conference will be held in 1935 in Belfast. The following officers have been elected: *Chairman*, Dr. F. W. Crossley-Holland; *Treasurer*, Mr. T. E. Lescher; *General Secretaries*, Mr. C. E. Corfield and Mr. G. R. Boyes.

A SCIENTIFIC society for the study of anæsthesia was founded last month in Paris on the initiative of Dr. Robert Monod. The society, the number of whose members will be limited to 100, has already admitted 6 chemists, 6 physicians, 30 surgeons, 6 otorhinolaryngologists, 5 physiologists, 2 neurologists, 2 obstetricians, 2 stomatologists and 1 physicist from France, Belgium, Italy and Switzerland.

AT a meeting of the Indian Association for the Cultivation of Science held in Calcutta on June 19, Sir Nitratan Sircar, consulting physician, and formerly vice-chancellor of the University of Calcutta, was elected president in place of Sir C. V. Raman, and a new committee of management was appointed. At the same meeting, Mr. J. N. Basu, Dr. Birbal Sahani, Dr. Ganesh Prashad, Dr. Bimala C. Law and Dr. J. N. Mukerji were elected vice-presidents; and Dr. S. K. Mitra was appointed secretary in place of Dr. K. S. Krishnan.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mechanical engineering at the Municipal Technical College, Hull—The Director of Education, Education Offices, Guildhall, Hull (Aug. 1). A lecturer in applied mathematics at the United College, University of St. Andrews—The Secretary (Aug. 1). Two chemists at the Royal Gunpowder Factory, Waltham Abbey—The Principal Clerk, Central Office, Royal Gunpowder and Small Arms Factories, Enfield Lock, Middlesex (Aug. 4). A headmaster of Middle Street Central Technical School, Newcastle-upon-Tyne—The Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne (Aug. 4). A lecturer in physics at the Norwich Technical College—The Principal, Norwich Technical College, St. George Street, Norwich (Aug. 4). A principal of the Carlisle Technical School—The Director of Education, Education Offices, 19, Fisher Street, Carlisle (Aug. 8). An aircraft inspector in the Civil Aviation Directorate of the Government of India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Aug. 11). An assistant organiser of agricultural education for West Suffolk—The Chief Agricultural Officer, West Suffolk, Shire Hall, Bury St. Edmunds (Aug. 11). A reader in industrial hygiene and medicine in the University of Birmingham—The Secretary (Sept. 1). An assistant lecturer in biochemistry in the University of Birmingham—The Secretary (Sept. 1). A temporary demonstrator in botany in the University of Leeds—The Registrar (Sept. 17).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Structure of the Azide Group

IN the account in NATURE of May 26, p. 802, of the recent discussion on dipole moments held at Oxford by the Faraday Society, reference is made to the probable linearity of the arrangement of the nitrogen atoms in the azide group. An X-ray examination of cyanuric triazide made by Miss Knaggs in the Davy Faraday Laboratory shows that this hypothesis is correct. I gave a short account of her work in a lecture at the Royal Institution at the end of last year. The arrangement bears a curious resemblance to the arms of the Isle of Man, a row of three nitrogen atoms lying in the position of each leg from knee to ankle.

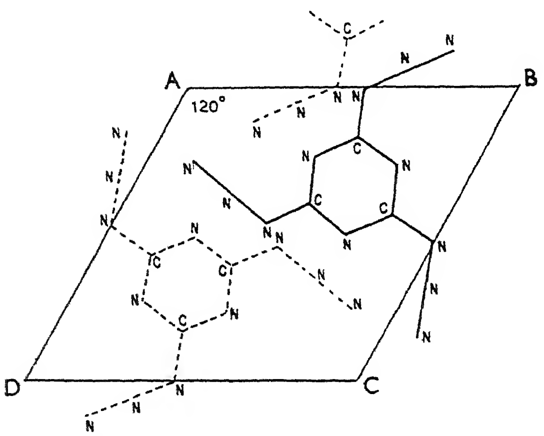

FIG. 1. Crystal cell of cyanuric triazide. AB=CD=8·73 A. Broken lines represent molecules separated from that represented by continuous lines by 2·98 A. parallel to the hexagonal axis of the cell.

Miss Knaggs has now nearly completed a Fourier analysis of the electron distribution in the molecule, which confirms her preliminary determination of the structure. It is a 'layer structure' and resembles that of graphite, but the arrangement in the layers is very different. The molecules are distinct and planar. The layers are closer together than in graphite, being only 2·98 A. apart as against 3·41 A. in graphite. The structure is interesting because it furnishes the data of distances between nitrogen atoms, and between nitrogen and carbon atoms, both in the same molecule and in neighbouring molecules.

Cyanuric triazide is highly explosive, which fact may be connected with its high density, 1·71, which is unusually high for an organic compound.

Fig. 1 shows the size of the cell, which is hexagonal, and the arrangement of the molecules belonging to it. The completed Fourier analysis will give the exact positions of the atoms.

W. H. BRAGG.

Royal Institution,
London, W.1.
July 3.

Orientation of Molecules in the *p*-Benzoquinone Crystal by X-Ray Analysis

K. S. KRISHNAN and S. Banerjee[1] have recently deduced the orientation of the molecular planes in this crystal by a study of the magnetic susceptibilities. The structure is an interesting one because they find that the plane of the benzene ring is almost coincident with the $(20\bar{1})$ plane of the crystal.

Cases of this kind in which all the atoms of an organic compound are coincident or nearly coincident with a simple crystallographic plane are unfortunately very rare, so it is worth while to inquire to what extent this relationship is an exact one. The magnetic results indicate that the plane of the molecule is inclined about 3° from the $(20\bar{1})$ towards the c axis.

A quantitative X-ray investigation of this structure has now been carried out, and the results are in agreement with the magnetic measurements, but go further, in that the complete orientation of the molecules can be determined, as well as the inclination of their planes. The results show that the small departure of the molecular planes from coincidence with the $(20\bar{1})$ is quite definite, and also that they are inclined in such a way that the planes of adjacent molecules are not quite parallel. Thus the measured values of F for the first three orders of the $(20\bar{1})$ reflection are 51, 24, and 5·5, as compared with calculated maxima of about 60, 29, and 14, which would apply if all the atoms were in phase. The large falling off in the case of the third order can best be explained by some departure of the atoms from exact coincidence with this plane. Further, any structure placing the atoms strictly in the $(20\bar{1})$ plane would give the orders of the (200) reflection the same geometrical structure factors as the orders of the (001), whereas there are actually considerable differences.

The crystal is monoclinic, $a = 7\cdot03$, $b = 6\cdot79$, $c = 5\cdot77$ A., $\beta = 101\cdot0°$, space group $P2_1/a$, with two centrosymmetric molecules per unit cell. Assuming a planar model with the oxygen atoms at 1·2 A. from the benzene carbon, the following orientation is found to give a reasonable quantitative explanation of the intensities of more than seventy reflections which have been measured. The line joining the two oxygen atoms in the molecule makes 79° with the a axis of the crystal, 37·5° with the b axis, and 54·5° with the normal to the (001). The line at right angles to this, also in the plane of the molecule, makes 70°, 127°, and 44° with these crystal directions. As the dimensions and scattering power of the two oxygen atoms in the molecule are somewhat uncertain, it would be unsafe to estimate the possible error in these figures at less than 3° or 4° at present. But it seems quite certain that the molecular planes depart from parallelism with the $(20\bar{1})$ by between 3° and 7°.

Starting from the above approximation, the experimental measurements are now being subjected to a Fourier analysis by which it is hoped to obtain more precise information regarding the structure of the molecule.

J. MONTEATH ROBERTSON.

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Royal Institution,
London, W.1.
June 22.

[1] NATURE, 131, 653, May 6, 1933.

Supraconductivity and the Hall Effect

IN connexion with the recent discovery of several new supraconductors[1], a re-investigation of zinc was undertaken, in development of the previous work of this laboratory[2]. In polycrystalline zinc, the $R\sigma$ value is so big that the recent discovery of supraconductivity in this metal should be considered as an exception to our previously established rule. But zinc crystallises in the hexagonal system and possesses a very definite anisotropy of physical properties. For this reason we decided to investigate monocrystalline zinc. Two kinds of plates of it were prepared: in one, the main axis lies in the plane of the plate, the primary current being parallel to the direction of the axis; in the other, the plane of the plate is perpendicular to the main axis. For both orientations the Hall coefficients have been determined, the corresponding conductivities parallel to (σ_1) and perpendicular to (σ_2) the axis, being taken from the tables. We obtained the following results:

$$|R\sigma|_1 = 14$$
$$|R\sigma|_2 = 300.$$

Thus it is seen that the violation of our rule in this case is only an apparent one. *Zinc seems to belong to the group of supraconductors in one particular crystallographic direction only,* and it supports strongly our rule.

It should be very important to determine the supraconductivity phenomena in different crystallographic directions. From the experimental point of view, such an investigation is, however, likely to meet very considerable difficulties, especially concerning the interpretation of the experimental results thus obtained.

B. LASAREW.

Physical Technical Institute
of the Ural,
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June 4.

[1] W. Meissner, *Z. Phys.*, **87**, 206; 1933—Supraconductivity of vanadium. W. H. Keesom, *Proc. Amsterdam*, **36**, 381; 1933—Supraconductivity of aluminium. W. H. Keesom, *Physica*, **1**, 123; 1934—Supraconductivity of zinc.

[2] Kikoin and Lasarew, NATURE, **129**, 57, Jan. 9, 1932. *Phys. Z. Sowjetunion*, **3**, 351; 1933. Dorfman, *Metallwirtschaft*, **12**, 221; 1933. Lasarew, *Phys. Z. Sowjetunion*, **4**, 567; 1933.

Nature of a Magnetic Field

IN a paper read before Section A of the British Association last year, I gave some account of experiments made by Dr. Norgrove and myself on cylindrical magnets and solenoids spinning about their axes. These experiments forced us towards the conclusion that even in the strongest permanent magnet there was no evidence of any attachment between the metal and the system of tubes of induction to which it is supposed to give rise. All our tests then and since have only confirmed Faraday's words as to the "singular independence of the magnetism and the bar in which it resides".

It has occurred to me recently that, apart altogether from the tests referred to above, accepted theory also supports our view as to the stationary magnetic flux. Zeleny and Page[1] have shown that no current circuit, even if it passes in part through the magnet, can exert a torque about the axis of symmetry of a symmetrically magnetised cylinder. This is entirely in accord with our experiments. It follows that the torque exerted on the magnet by the current can only be due to the interaction between the field and current within the magnet. If this be admitted, the question as to whether the tubes of induction are attached to the metal of the magnet is at once settled. Consider a horizontal section of a vertical cylindrical magnet through which the flux of induction φ is upwards. If now current i pass radially inwards at the equator, the torque is $i\varphi/2\pi$, and the magnet tends to turn in the positive direction viewed from above. To produce this couple, if one of the components i or φ is assumed to be attached to the particles of the magnet, the other must be independent thereof. But the direction of the twist shows us which is which. For if the tubes of induction were attached to the molecules of the metal, while the current sheet remained independent and stationary, the motion of the magnet would be in a direction *opposite to that which is found by experiment to exist.* The conclusion, therefore, is unavoidable that the magnetic field is the independent and stationary quantity, the drag on the metal being due to the deflection of the moving electrons forming the current which must in their turn, either by collisions or by attractions, act upon the atoms of the metal.

Two further results follow. First, if a current is led into and away from a rotating bar of metal of any kind, more power will be needed to cause the rotation when the current is flowing than when it is switched off. Second, in an electric circuit made up of stationary conductors and a spinning magnet, the generation of the E.M.F. takes place in the magnet itself, and not in the stationary conductors.

WILLIAM CRAMP.

The University,
Edgbaston, Birmingham, 15.
July 5.

[1] *Phys. Rev.*, Ser. 2, **24**, 544.

Measurement of Ultra-Violet Light

IN measuring the amount of ultra-violet light reaching the earth from sun and sky, it is customary to expose the acetone methylene blue tube in the vertical position. Since more ultra-violet light is received from the sun itself than from the whole of the rest of the sky put together, the vertical position seems unsuitable, for the amount of ultra-violet light received by the contents of the tube will be too low during the time of day and year when the sun is most nearly overhead. The horizontal position has occasionally been used, but this is open to the opposite criticism.

The Oxford University Expedition has recently been measuring the ultra-violet light in the New Hebrides, in the tropical Pacific. If we had used the vertical position for the tube, then, on the two days of the year on which the sun passed directly overhead, the tube would have received practically no ultra-violet light from the sun at the very time (midday) when the irradiation was likely to be at its greatest. We therefore always exposed both the quartz tube and the control glass tube on a simple wooden stand (Fig. 1) kindly made for us by my brother, Mr. S. J. Baker. This stand was set up so that the ends of the tubes always pointed north and south, and their inclination was changed each month so that the rays of the sun always fell approximately at right angles upon them. (Weekly changes could

easily be made, if it were thought advisable.) The movable part of the frame is marked with the names of the months, and each month it is turned slightly on its axis so as to bring the name of the new month opposite a mark on the stationary part of the frame. Fig. 1 shows the instrument inclined for the month of October in latitude 15° S., the north being to the right of the picture. The shadows show that the rays of the sun are striking the tubes approximately at right angles. It is, of course, necessary to mark the names of the months on the instrument according to the latitude in which it is to be used.

It is easy to show the importance of a correct exposure of the tubes by exposing a second pair in the vertical position at the same time.

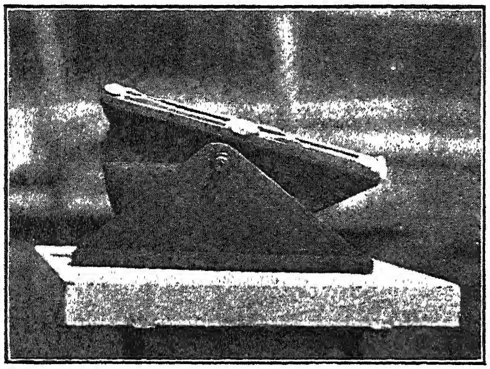

FIG. 1. Frame for exposing acetone methylene blue tubes.

My brother suggests the following alternative to my method of exposure. The tubes could always be exposed parallel to the axis of the earth, and a correction applied to the resulting figures to compensate for the varying obliquity of the rays during the different months of the year. Another plan would be to use spherical instead of tubular containers for the acetone methylene blue.

The expedition to the New Hebrides was supported by the University of Oxford, the Royal Society, the Royal Geographical Society and the Percy Sladen Trust. Ultra-violet light observations are still being made in the New Hebrides by members of the expedition. All the meteorological results will be published in full when a year is complete.

University Museum, Oxford. JOHN R. BAKER.
June 15.

New Features of the Nitrogen Afterglow

A STUDY has been made of the nitrogen afterglow formed by passing nitrogen containing 0·25 per cent of oxygen through an uncondensed discharge produced by a 25,000-volt transformer.

For the same type of discharge tube at 0° C. the relations for velocity, pressure, and voltage are quite similar to those found for hydrogen afterglow by Van Cleave and Grubb[1]. When the critical voltage is reached, a greenish yellow glow appears in great intensity. At certain adjustments of pressure, velocity, and voltage, the afterglow shows many of the colours of the aurora. These colours are all visible at the same time, but at different distances from the discharge, the blue being the farthest removed. If the discharge tube is immersed in a bath at 30° C., the glow disappears, but if the temperature is lowered to $-20°$ C., the glow is intensified.

The spectrum in the visible consists of first positive, second positive, first negative and nitric oxide bands. A line appears at λ5577 which confirms the observation by J. Kaplan[2]. The plate also shows a first negative band at λ4780 which is not reported by T. R. Merton and J. G. Pilley[3]. This band appears to be λ4779 observed in the aurora by Vegard[4]. Other bands of the first negative system are superimposed upon the β bands, which results in a different order of intensity than reported by Johnson and Jenkens[5]. The band λ4059 of the second positive system is also quite intense.

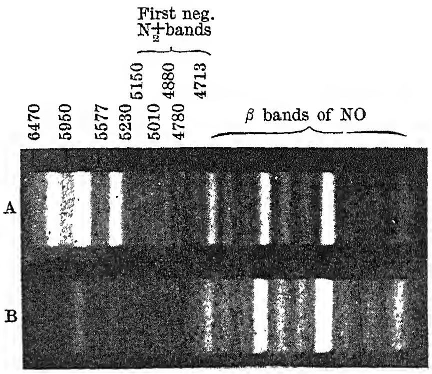

FIG. 1. A: Nitrogen afterglow; primary 50 volts, pressure 10 mm., flow 4 litres/hour. B: Afterglow in nitrogen with 0·01–0·05 per cent sulphur dioxide; primary 50 volts, 110 watts, 2·4 amp.; 4 litres/hour; eight hours.

The upper spectrogram of Fig. 1 shows the bands of the afterglow taken under conditions such that the afterglow showed traces of green and blue. The lower spectrogram shows the bands of the afterglow with 0·05 per cent of sulphur dioxide added to the nitrogen before passing the gas through the discharge. The alpha and the first negative bands are considerably quenched while the beta bands are enhanced.

If the nitrogen is bubbled through concentrated sulphuric acid before passing through the discharge, the yellow afterglow is replaced by a blue glow. The blue glow shows a few of the prominent beta bands in the violet and a continuous spectrum in the blue. This is a very striking proof that bubbling a gas through concentrated sulphuric acid contaminates the gas with oxides of sulphur.

Details of this work will appear in a subsequent publication.

H. A. JONES.
A. C. GRUBB.
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University, Saskatchewan.

[1] NATURE, **132**, 1001, Dec. 30, 1933.
[2] *Phys. Rev.*, **33**, 154; 1929.
[3] *Phil. Mag.*, **50**, 195; 1925.
[4] *Phil. Mag.*, **46**, 198; 1923.
[5] *Phil. Mag.*, **2**, 621; 1926.

Production and Planning

To the now rapidly growing number of students of monetary reform, the leading article of July 7 will appear to be profoundly unscientific.

The abundance which is at present being produced below cost, and the outstripping of demand by production of the primary commodities, are viewed as phenomena not of over-production, but of under-consumption.

Real wealth is a matter of goods and services—

money is but a token for real wealth—a convenient method of representing its exchangeable value. These tokens cost practically nothing to produce; their value depends on the goods the exchangeable value of which they represent. Means of producing real wealth have enormously increased. There has been no corresponding method evolved by orthodox finance of insuring that, as production increases, the tokens for goods shall also increase in a like proportion.

Hence the entirely unscientific procedure of *reducing* the production of real wealth (in primary commodities) in order to balance an artificially restricted purchasing power due to a deficiency of tokens, and the tragic blunder of burning wheat in one country while millions are starving in another, and shipping personnel (who would gladly carry the wheat where it is wanted) are unemployed.

What is needed is surely not "salesmanship", or "to stimulate export trade between nations" (the world export trade is but an insignificant item in comparison with national trades) but a better understanding of the nature and function of money, and a scientific method of the issue of money in accordance with the ability of the community to produce *all* the goods which they would be glad to consume, plus a surplus which can be exchanged (directly or indirectly) for such raw materials or specialised products as they require, but cannot produce.

In Great Britain we could easily double our present rate of goods production, and double our consumption, so as to raise the standard of material well-being of our community; we could also feed ourselves.

The present monetary system would, however, have to be altered so that purchasing power equivalent to increased producing power was given to the community.

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July 9.

WE could not possibly find space in our correspondence columns for a discussion of monetary systems; but we may say at once that we find ourselves quite unable to agree with Sir Richard Paget that planning is unscientific. Admittedly a great responsibility rests on the planners, but there is no practicable alternative at the moment to planning. In the present temper of the world, national needs have to be served first, but we must see to it also—and here science can help—that the planning is eventually international. So long as proper prices are obtained for the goods produced in Great Britain it is possible to pay satisfactory wages, salaries and dividends and so to enhance the spending power of everyone. When the goods manufactured are sold at or below the cost of production, as the result of competitive overproduction, wages and salaries are depressed to a minimum, dividends disappear, and the purchasing power of the nation sinks to mere sustenance level. We fail to understand how the production of goods below cost is the equivalent of real wealth; surely it has the contrary effect. No juggling with monetary systems will obviate this state of affairs; indeed, where the experiment has so far been tried it has not been exactly attended with success.

THE WRITER OF THE ARTICLE.

Electrical Conductivity of Salts in Anhydrous Hydrogen Cyanide

AN accurate determination of the conductivity of salts in anhydrous hydrogen cyanide is of considerable interest in view of the high dielectric constant of this solvent. Indications of high values for the equivalent conductance were obtained by Centnerszwer[1], Kahlenberg and Schlundt[2], and, more recently, by Fredenhagen and Dahmlos[3]. These investigators confined their measurements to relatively concentrated solutions, and came to the conclusion that hydrogen cyanide is but a poor dissociating solvent in spite of its high dielectric constant (119 at 18° C.)[3].

We have undertaken a systematic investigation of this subject, and have first determined the conductivities of a considerable number of uni-univalent salts in the concentration range 0·0001–0·005 *N*, since it is in this range that the Debye-Hückel-Onsager equation may be tested. The preliminary measurements have been made among the chlorides, bromides, iodides, nitrates, perchlorates, thiocyanates, and picrates of lithium, sodium, potassium, ammonium, tetramethyl ammonium, and tetraethyl ammonium.

The results may be briefly summarised as follows:

Most of the salts obey the Kohlrausch empirical relation $\Lambda_c = \Lambda_0 - x\sqrt{c}$ over the whole concentration range investigated, and the values of x found are in fair agreement with those calculated by means of the Debye-Hückel-Onsager equation.

It appears that for the alkali metal ions there is an increasing tendency to ionic association in the order $K^{\cdot} < Na^{\cdot} < Li^{\cdot}$, which is the reverse order to that in water, although, as in water and the other hydroxylic solvents, both the chlorides and nitrates of these metals show association more than the other salts.

The Λ_0 values have been obtained by extrapolation of the straight line portions of the $\Lambda_c/\sqrt{c}$ plots. The values are about three times as great as those in water; for example, potassium chloride in water at 18° gives $\Lambda_0 = 129{\cdot}8$, whilst the value in hydrogen cyanide is 363·0. The Λ_0 values are in agreement with the 'law of independent mobilities of ions', and thus support the conclusion that all the salts are almost completely dissociated at the dilutions employed:

	Br'	I'	NO_3'
$K^{\cdot}$	363·4	364·2	353·5
$Na^{\cdot}$	344·0	344·3	333·7
$l_{K^{\cdot}} - l_{Na^{\cdot}}$	19·4	19·9	19·8

As yet, no data are available for the calculation of the absolute mobilities of ions in hydrogen cyanide, but according to the Λ_0 values we may place the ions in order of increasing mobilities:

Cations: $Na^{\cdot} < Li^{\cdot} < NEt^{\cdot}_4 < K^{\cdot} < (NMe^{\cdot}_4,\ NH^{\cdot}_4)$
Anions: Picrate $< NO_3' < ClO_4' < CNS' < Cl' < Br' < I'$.

A complete description of the experimental procedure, and a discussion of the results obtained, will be published elsewhere shortly.

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E. G. TAYLOR.

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June 15.

[1] *Z. Phys. Chem.*, **39**, 220; 1902.
[2] *J. Phys. Chem.*, **6**, 447; 1902.
[3] *Z. anorg. Chem.*, **179**, 77; 1929.

Concentration of Heavy Water by Spontaneous Evaporation

IT has been stated that deuterium can be concentrated much more efficiently by the spontaneous atmospheric evaporation of water than by boiling[1]. This suggestion is based on an experiment in which Poznań water, by spontaneous evaporation to 1/40 of its volume, gave a residue claimed to contain 1·65 per cent of deuterium. The experiment would appear to be incorrect, however, for even assuming 'semipermeable membrane' separation ($\alpha = \infty$) the proportion of deuterium in Poznań water would, according to this experiment, have the highly improbable value 1/2,500. Of course, the separation coefficient, α, cannot be infinity: under ideal conditions it could amount to the isotopic vapour pressure ratio. Taking $\alpha = 1{\cdot}15$ as an outside figure, the deuterium content of Poznań water, according to the reported evaporation experiment, becomes 1/100.

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C. K. INGOLD.
C. L. WILSON.

University College,
London.
July 13.

[1] T. Tucholski, NATURE, 134, 29, July 7, 1934.

Constitution of Vasicine

SPÄTH and Nikawitz[1] have investigated the behaviour of a base, $C_{11}H_{12}ON_2$, termed peganine, which the firm of E. Merck (Darmstadt) isolated from the mother liquors of the alkaloids of *Peganum harmala*. A little later, Späth and Kuffner[2] found that peganine is identical with the base vasicine isolated from *Adhatoda vasica*, Nees, by Sen and Ghose[3] and more recently studied by Ghose, Krishna, Narang and Rây[4]; the name peganine therefore becomes superfluous.

The formulation of vasicine by Späth and Nikawitz as 4-hydroxy-3-allyl-3 : 4-dihydroquinazoline (*A*) did not appear satisfactory to us on the basis of the evidence submitted. This constitution is that of the carbinol base of an alkylquinazolinium salt, and it would be highly surprising if such a substance could, like vasicine, be converted into a volatile chlorodeoxybase or acetyl derivative. It was scarcely more credible that such a carbinol base would form normal salts *B*, HCl instead of the usual *B*, HCl–H_2O, and yet many vasicine salts of the first-cited form have been described. Admittedly these considerations are not infallible guides, and substances do occasionally exhibit totally unexpected properties; fortunately, however, the validity of the Späth–Nikawitz suggestion can be quickly tested experimentally, because the synthesis of (*A*) may be effected without difficulty.

Allyl iodide and quinazoline combine with formation of 3-allylquinazolinium iodide and this salt (or the corresponding chloride), reacting with alkalis in aqueous solution, yields the carbinol base (*A*), which crystallises from benzene in well-formed colourless prisms, m.p. 130° (vasicine, m.p. 208°–210°) (Found : C, 70·4; H, 6·4; N, 14·6. $C_{11}H_{12}ON_2$ requires C, 70·2; H, 6·4; N, 14·9 per cent).

A further description of this and analogous bases will, it is hoped, be published in another place.

It is apparent that vasicine cannot be correctly formulated in accordance with the proposal of Späth and Nikawitz. Of the alternative formulæ rejected by these authors in the course of their discussion, that numbered VI (*loc. cit.*, p. 48) seems to fit the facts best, but it is not wholly satisfactory for several reasons including the optical inactivity of vasicine.

The final sentence of the memoir of Späth and Kuffner is the following: "Über Einzelheiten der Vasicin-Literatur wollen wir gegenwärtig nicht das Wort ergreifen, sondern die weiteren Ergebnisse der indischen Forscher abwarten." May we be allowed to follow this excellent example, bracketing, however, our Austrian with our Indian colleagues.

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University, Oxford.
June 26.

[1] *Ber.*, **67**, 45; 1934.
[2] *ibid.*, 868.
[3] *Quart. J. Ind. Chem. Soc.*, **1**, 315; 1924.
[4] *J. Chem. Soc.*, 2740; 1932.

Synthesis of Vitamin C by the Infant

THE presence of vitamin C in human urine has been recently shown both by tests with the Bezssonoff reagent and dichlorphenol-indophenol[1] and also demonstrated by animal experimentation[2]. We designate as U.H. the unit of violet coloration produced in 1 c.c. of water by 1/1,000 mgm. of hydroquinone, in the presence of the Bezssonoff reagent $(MoO_3)\,(WO_3)_{17}(P_2O_5)\,(H_2O)_{24}$. A solution of pure vitamin C, N/100,000, gives a coloration of 1 U.H. This was verified with samples of ascorbic acid received from Micheel, Szent-Györgyi and Reichstein. We have actually tested, by this reagent, the urine of infants of 2–23 months in age, submitted during 48 hours to a diet deprived of vitamin C. The following are the results (Fig. 1):

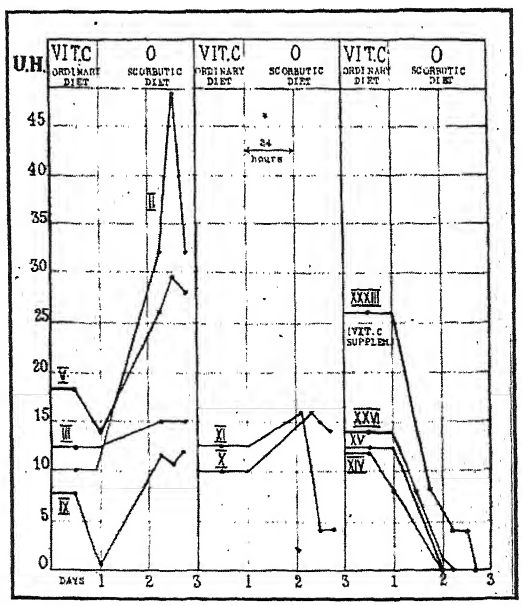

FIG. 1.

The curves indicate the variation of amount of vitamin C in the urine; the age of the infants, in months, is given by Roman numerals.

Like the rat and the bird, the human infant possesses the faculty of producing vitamin C. This faculty, markedly evidenced up to the age of 5 months, is afterwards diminished and disappears in infants of 14 months or above. It should be mentioned that the excretion of vitamin C in the urine often ceases in sick or dystrophic infants.

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June 8.

[1] N. Bezssonoff and A. Delire, *C.R. Acad. Sci.*, **197**, 1774; 1933. N. Bezssonoff and H. Van Wien, *C.R. Soc. Biol.*, **115**, 1277; 1934.
[2] M. Van Eekelen, A. Emmeric, B. Josephy and L. Wolf, *Klin. Wochenschr.*, **13**, 564; 1934.

Isomerism of Sucrose and Iso-Sucrose

ALTHOUGH an adequate constitutional formula for sucrose has been developed, attempts to verify this structure by synthesis have led to no success, the only crystalline product isolated being an isomeric disaccharide termed *iso*-sucrose. Presumably the isomerism resides in the α or β configurations of the glucose and fructose residues present in this disaccharide; and, if so, both sucrose and *iso*-sucrose should behave in parallel fashion when subjected to the methylation process.

We have effected the complete methylation of *iso*-sucrose by the use of liquid ammonia as a solvent in the final stages of the process. The octamethyl *iso*-sucrose thus obtained was converted by hydrolysis into an equimolecular mixture of tetramethyl glucose and tetramethyl γ-fructose. The two sugars were separated by condensation with methyl alcohol under conditions in which the methylated fructose alone reacted and the resulting mixture was then benzoylated. In this way tetramethyl γ-methylfructoside and tetramethyl benzoylglucose were formed and were thereafter readily separated. In the one case, debenzoylation gave tetramethyl glucose and, in the other, mild hydrolysis yielded tetramethyl γ-fructose.

The result is conclusive and shows that *iso*-sucrose is a stereoisomeride of sucrose in the sense that it is a gluco-fructose containing a normal glucose residue coupled with a γ-fructose residue. The research is being extended.

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July 7.

Mechanical Twinning in Bismuth Crystals

SINGLE crystals of bismuth are stated by many authors[1] to exhibit mechanical twinning on the planes of type (110). The twinned part has the form of a thin lamella parallel to the twinning plane. On the (111) cleavages they appear as narrow stripes along which the surface is slightly inclined to the (111) face. These inclined faces are of the $(11\bar{1})$ type. Therefore the atoms which formed the (111) plane before the twinning occurred, form after twinning—at least partially—the $(1\bar{1}\bar{1})$ plane.

In compression tests with bismuth crystals made by the Bridgman method, another kind of mechanical twin appeared. The most important features of it are: The change in shape and size of the crystal is much bigger than that due to a (110) twin. The twinned lamella is always comparatively thick, of the order of millimetres. The lamella lies along one of the $(7\bar{5}1)$ planes. If one cleaves a crystal which contains such a twinned lamella the $(1\bar{1}\bar{1})$ cleavage runs perfectly through the twinned part—of course, in a changed direction. This change in direction differs slightly from one crystal to another, owing to slip in the twinned part, as such twins only occur at comparatively high stresses. From its appearance, one can conclude that the cleavage through the twinned part is the (111) plane of the twinned structure. The atoms of the (111) planes therefore remain atoms of the (111) plane in the twin. Thus one is able to find the position of the twinning plane.

Measurements indicate $(7\bar{5}1)$ as the twinning plane, one individual being the mirror image of the other with respect to this plane. In a hexagonal system of axes, which is sometimes used for bismuth, it is the $(22\bar{4}1)$ second order pyramidal plane. In this notation the usual twinning plane (110) in the rhombohedral system of axes becomes the $(10\bar{1}\bar{2})$ first order pyramidal plane.

It is remarkable that a plane of so low atomic density can be the twinning plane. However, a quite simple movement, which consists essentially of slip in the usual plane of slip (111), suffices to explain the formation of the twin.

Rather large specimens of the twins on the (110) planes were observed when a tensile test at higher temperature was applied to a bismuth crystal. I have already pointed out[2] that bismuth crystals slip in tensional tests at room temperature only if they contain gas. At higher temperatures (250° C.), however, even crystals without gas exhibit slip in tensional tests. An 'after elongation thread', such as occurs on zinc[3], of appreciable length was observed which was due to slip in a rather big twinned portion of the crystal. The twinning plane was the (110) plane. No other kind of twins was seen in these tests.

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June 15.

[1] Compare H. T. Gough and H. L. Cox, *J. Met. Inst.*, **48**, 227; 1932.
[2] NATURE, **133**, 831, June 2, 1934.
[3] H. Mark, M. Polanyi and E. Schmid, *Z. Phys.*, **12**, 58; 1922. Also C. H. Mathewson and A. J. Phillips, *Proc. Inst. Met. Div. Amer. Inst. Min. Eng.*, 143; 1927.

Wasting Disease of Eelgrass (*Zostera marina*)

IN NATURE of December 30, 1933, a letter appeared on the disease of the eelgrass (*Zostera marina*) in Danish waters based on investigations which I made in the summer of 1933. I am now able to give further details concerning this disease. The destruction of the leaves was continued during the winter, but young shoots formed in the early spring were generally without infection. Infection of the leaves reappears at the beginning of the summer.

At the same time also, a fructification, a formation of spores, in the rhizomes is nearly completed. During the winter and the spring the rhizomes are frequently found to be infected with mycelium referred to in my previous letter and now in June I have found, in the northern Kattegat, in the rhizomes *in situ*,

abundant perithecia resembling organs (evidently true perithecia) which produce long spores. The new infection in the leaves is evidently due to these.

So far as I can judge, there has been, and still is, in Danish waters a high maximum of a fungus in the eelgrass and a wasting disease, connected with in several places a nearly total extinction of this plant. It is therefore suggested that the fungus here is the cause of the disease.

The systematic position of the fungus is not yet clear. The spores are long and flexible and in shape similar to the ascospores of *Ophiobolus*, but they do not seem generally to fall into fragments; also the ascus walls are dissolved very early. It may be *Ophiobolus maritimus* Sacc., but if so, this species should be referred to another genus.

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June 23.

Importance of Carbohydrate Supply in Legume Symbiosis

EXPERIMENTAL evidence, which has been accumulating for a number of years, but especially more recently, emphasises the importance of carbohydrate in nodule development and nitrogen fixation in leguminous plants inoculated with effective bacterial strains. There are, however, certain facts well known to plant physiologists which deserve greater emphasis in this connexion: (*a*) An abundant supply of nitrogen is conducive to top growth while a wide carbohydrate-nitrogen ratio favours root growth. The carbohydrate-nitrogen relations may be altered by changing the conditions for photosynthesis, by varying the nitrogen additions to the culture medium, and by supplying sugars to the roots. (*b*) During active photosynthesis a sugar concentration gradient[1], decreasing downward, commonly exists between the leaves and roots of higher plants. These synthesised sugars usually[2] do not remain long in this form; a considerable portion, 20 per cent or more, is required for respiration, while the remainder is either used for growth or is stored largely as starch.

If these facts, which apply rather generally to higher plants, are borne in mind in connexion with legumes, it is believed that many observations and experimental facts reported in the past in connexion with the nodulation of these plants, may be more satisfactorily explained.

The failure of nodules to develop normally in the presence of an abundance of fixed nitrogen is a good example[3]. In this case, where the carbohydrate-nitrogen ratio is narrow, most of the photosynthetic carbohydrate is used for top growth and only a small percentage reaches the roots. The condition in this case is similar to that existing in plants grown at low light intensities on soils containing only the usual small quantities of soluble nitrogen. In both cases the carbohydrate supply in the roots is so low that only a limited growth occurs. A high carbohydrate concentration is not essential for bacterial entrance into the root, but abundant nodule development takes place only provided the carbohydrate supply is adequate for good root growth. The frequent observation that root and nodule growth are favoured to a remarkable extent by additions of sugar emphasises the importance of this factor.

Nodule location on plants, uniformly inoculated, may also be closely correlated under many conditions with available carbohydrate supply in the root at the time of nodule development. Normally, nodules on annual legumes are located chiefly near the upper parts of the main root system, nearest the source of carbohydrate supply. On the other hand, they are usually widely scattered where the plants are grown either in water cultures, or in a nitrogen-free atmosphere, or in the presence of increased carbon dioxide, and when produced by ineffective strains. In all these cases, carbohydrate is usually abundant almost to the root tips.

The limited data dealing with the energy requirements for the chemical process of nitrogen fixation in the nodule, as distinguished from the respiration and growth requirements of the bacteria and host, can now be interpreted with a greater degree of certainty. These fixation requirements appear to be negligible. The bulk of the carbohydrate is consumed in respiration and growth, chiefly of the host.

The intimate relations existing between the nodule bacteria and their hosts now seem less complicated than formerly supposed. In the past, various theories, involving such ideas as immunity and relative vegetative energy of the symbionts, have been advanced. The newer evidence, together with the old, tends to place much greater emphasis on carbohydrate nutrition, so far as effective bacterial strains are concerned. If the carbohydrate supply is adequate, nodules usually develop and nitrogen fixation roughly parallels the growth of the higher plant; if the supply then becomes deficient, the bacteria sometimes remain dormant, or in other cases may attack the tissues of the host to obtain food, as investigators at Rothamsted have repeatedly pointed out.

This communication summarises several of the more important ideas considered more fully in a manuscript entitled, "Carbohydrate Supply as a Primary Factor in Legume Symbiosis", to be published shortly.

FRANKLIN E. ALLISON.

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U.S. Department of Agriculture,
Washington, D.C.

1 Mason and Maskell, *Ann. Bot.*, **48**, 119–141; 1934.
2 Arthur, Guthrie and Newell, *Amer. J. Bot.*, **17**, 416–482; 1930.
3 Allison and Ludwig, "The Cause of Decreased Nodule Formation on Legumes Supplied with Abundant Combined Nitrogen", *Soil Science*, in Press.

British Association: Aberdeen Meeting, 1934

HAVING been informed that in some quarters it has been stated that the lodging accommodation available for members at the meeting of the British Association in Aberdeen on September 5–12 next is limited, we hasten to take the earliest opportunity of assuring members who propose coming to the meeting that there is ample accommodation available.

While it is true that most of the hotel accommodation, with the exception of some double bedrooms, has already been booked up, the Local General Committee has in hand a large reservation of private lodgings of a suitable type and reasonable tariff.

We may state that the local arrangements are well in hand, and that members of the Association coming to Aberdeen are assured of a cordial welcome and an interesting programme.

E. W. WATT.
H. M. MACDONALD.
Local Hon. Secretaries.

Town House,
Aberdeen.
July 12.

Research Items

Behaviour of the New-born Monkey. Observations on eleven new-born monkeys in the Carnegie colony of the Department of Embryology, Carnegie Institution of Washington, are recorded in the Year Book (No. 32, 1933). Additional data were derived from subsequent pregnancies in this colony and from one of another species of macaque born in the Yale colony. The full-term macaque baby opens and closes his eyes, cries, reaches out and grasps objects with his hands before he is completely delivered. At birth his flexor muscles are more precocious than his extensors, and their principal function appears to be the seeking of bodily support. By the second day there is a tendency to climb upward. By the end of the first week all the sensory mechanisms show evidence of functioning and the sensory-motor co-ordination develops much more rapidly than in the human infant. Play activities, such as romping, jumping, attempts to leap upon and seize objects, appeared during the second and third weeks but co-ordination of eye and hand and distance perception were quite imperfect. In the relationship of mother and baby much of the behaviour is subject to mechanistic explanation. Equipped with his grasping tendencies and the associated ventro-ventral position, the nosing and mouthing activities of the infant result in the discovery and seizure of the nipple, unaided by the mother. If the baby, through immaturity, lacks sufficient strength and co-ordination to accomplish these ends himself, the mother instinct is inadequate for the predicament, and he perishes.

Temperature Range in Rats. Alexandrine rats (*Rattus rattus alexandrinus*) found in dwelling-houses in Tokyo, were used by N. Yagi and J. Shimoizumi in experiments to determine the limits of body temperature which could be tolerated (*Sci. Rep. Tokyo Bunrika Daigaku*, 1, No. 22; 1934). The body-temperature was measured by the thermocouple method. Normal body temperature ranged from 36·85° to 37·45° C. Lethal low temperature was found to lie between 12·45° C. and 14·6° C., and lethal high temperature 42–43° C. Almost no relationship was discovered between the range of the lethal temperatures and the body weights of the rats, but male rats had a slightly longer range of tolerance at both ends of the scale, the average lethal low temperature being 13·41° C. for males, 13·76° C. for females; and the average lethal high temperature 42·68° C. for males, and 42·19° C. for females. The numbers of rats used in the experiments were 18 (10 males, 8 females) for lethal low temperature, and 18 (11 males, 7 females) for lethal high temperature.

A Fish New to the British Fauna. Prof. W. M. Tattersall (*Ann. and Mag. Nat. Hist.* (10), 13, No. 75, March 1934) records *Ruvettus pretiosus*, Cocco, for the first time from British waters. This fish was caught in September 1933 by one of the Cardiff trawlers in lat. 52° 20′ N., at a depth of 180–200 fathoms. This is due west of Co. Kerry in Ireland, and lies within the British area. Inhabiting the Atlantic at about 400 metres depth, *R. pretiosus* is common near the Canary Islands and Madeira and off the coasts of Spain and Portugal. It has been recorded from the Mediterranean and in the waters round the West Indies; also from Hawaii and Japan. The present specimen measures 3 ft. 7 in. in length, the largest known being 6 ft. It is apparently a straggler from warmer waters, although inquiries into the temperature from the nearest station of the Irish Fishery Board to the locality at which the fish was taken show that while the surface temperatures exhibit considerable variation over several years, the water at 400 metres has not varied more than half a degree over the whole series of years covered by the data. As the author states, "It would seem therefore that the temperature of the water at the bottom could not have been a factor influencing the distribution in any marked way, and cannot be brought into account for its presence off W. Ireland this year and its apparent absence in other years".

***Uronectes fimbriatus*, a Fossil Crustacean.** Dr. W. T. Calman (*Ann. and Mag. Nat. Hist.*, (10), 13, No. 75, March 1934) gives a detailed description of this interesting Permian fossil which was the first to be discovered of those fossil Crustacea now generally grouped together with the recent *Anaspides* and its allies under Packard's name *Syncarida*. There are a few specimens in the Geological Department of the British Museum (Natural History) from Lebach, near Saarbruck, the type locality. One of these is unusually fine, and from this the present description is mainly taken. A very good photographic plate is given of this, which lies on its side, and a second, ventro-lateral, of one from the same locality from the Geologisch-palæontologisches Museum der Universität, Bonn, presented by Dr. Jordan who, with Meyer, described this fossil (as *Gampsonyx*) in 1847. The close affinity between the Permian *Uronectes* and the carboniferous *Palæocaris* is confirmed by the identity of shape, position and even state of fossilisation of the appendages that are attached to the bases of the legs. The two genera are distinguished only by the enlargement of the second and third pair of thoracic limbs in *Uronectes*. In *Palæocaris* these limbs are similar to the following pairs. Further consideration of the precise relationship between the recent and fossil Syncarida must wait for a decision as to the nature of the basal appendages of the thoracic limbs in the fossil forms. Although there are probably exopods, they differ from those of the recent forms in absence or paucity of segmentation and lack of setæ.

The Scarlet Tulip of the East. A paper by Sir Daniel Hall in the *Gardeners' Chronicle* of June 16 and 23 clears up many difficulties of nomenclature connected with the scarlet tulip which flowers freely in countries of the Near East. Tulips which bear general resemblances to the scarlet eastern tulip have been variously described as *Tulipa oculus-solis*, *T. praecox*, *T. Boissieri*, *T. cuspidata*, *T. Stapfii*, *T. montana*, *T. undulifolia*, *T. lanata* and *T. Hoogiana*. Sir Daniel considers that these should all be classed as forms of one Linnean species—*T. oculus-solis*—with the possible exception of the triploids *T. praecox* and *T. Boissieri*. The specific characters of diagnostic importance are a woolly coating between the bulb and its tunic, an upright stem with usually a 'leg' of about 2 inches before any leaves emerge, and leaves which are somewhat glaucous and narrow pointed. The flower varies considerably in form and colour, but a central black or dark olive disc is almost universal, though even this is not of absolute diagnostic value.

Early Chrysanthemum Blooms. The fact that some plants bloom when the daily period of light is short, in spring and autumn, whilst others flower only in the long days of summer, was established on a sound practical basis by Garner and Allard in 1920. Since that time, horticulturists have been exploring the possibilities of a commercial application of the principle, and a recent publication by Mr. Kenneth Post reports considerable success in this direction ("Production of Early Blooms of Chrysanthemums by the Use of Black Cloth to reduce the Length of Day". *Bull.* 594, *Cornell Univ. Agric. Exp. Stat.*, Ithaca, New York, April 1934). Large box-shaped screens of black sateen were constructed to fit over chrysanthemum plants growing within a greenhouse. The screens were placed in position at 5 or 6 p.m. and were removed at 7 or 8 a.m., in order to provide a daily period of light of 10 or 11 hours. Large-flowered and Pompon types were caused to flower up to seventy days before their usual times. Treatment must be commenced whilst the plant is in the vegetative state, and is apparently ineffective when the flower buds have once formed. The publication under review reports the results of experiments on the effects of various lengths of day, the part of the plant affected, the time of day of treatment, the types of protective cloth, the dates of propagation and of last pinch, and the effect of short and long days alternated. There seems to be little practical difficulty in producing early chrysanthemum blooms ; can they be marketed when grown ?

Sexuality in Basidiomycetes. A useful paper dealing with sex in two members of the Basidiomycetes has recently appeared in *La Cellule*, 42, fasc. 3, pp. 249–266 ; 1934 ("Sexuality of *Polyporus ostreiformis* and *Polystictus hirsutus*" by Prof. S. R. Bose). Monosporous cultures of several strains of each of the two fungi were made on various nutritive media, and it was established that both were bisexual and heterothallic. Mycelia of both sexes remained stable when exposed to wide variations of temperature and light, and when treated with small amounts of chemical poisons. When haploid mycelia of different strain were sown on the same medium, a line or space of aversion was often formed where the two mycelial masses met, but diploidisation occurred and clamp connexions were formed. Diploid fruit bodies produced spores in abundance, but a few haploid fruiting organs which appeared either shed only a few spores for a short time, or produced none at all.

Re-Surveys in Earthquake Areas. In the United States, a sum of 10,000 dollars has been allotted annually for several years for geodetic surveys in regions of seismic activity. During the past year, an arc of close triangulation has been carried out from San Fernando to Bakersfield, California, 110 miles in length and crossing five major zones of active faulting. Another arc along the Californian coast will be of use in determining future movements along the San Andreas fault. The U.S. Coast and Geodetic Survey is now engaged on a plan for covering the whole country with arcs of triangulation and lines of level of first order, and it is estimated that it may be finished in five or six years. Eventually, when the networks of triangulation and levelling, with the 25-mile spacing of arcs and lines, are finished, it will be possible to measure vertical and horizontal displacements of the crust close to any region in which an earthquake may occur (Carnegie Inst., Washington, Year Book, No. 32, 362–364 ; 1933). In Japan, the bench-marks are about 2 km. apart, but even this distance may be too great to detect the movements of small crust-blocks. Prof. A. Imamura has studied the tilting of a crust-block only 4½ km. across in the Kyoto-Osaka district by means of a series of eleven new bench-marks only half a kilometre apart. The block is bounded to the east and west by well-marked faults. Up to 1928, it was tilted to the west at the rate of 0·5″ a year. Since then, the tilting has been reversed, though the rate remains almost the same (*Tokyo Imp. Acad. Proc.*, 10, 69–72 ; 1934).

Magnetic Survey of Sweden. In *Kungl. Sjökarteverket, Jordmagnetiska Publikationer*, No. 9 (Stockholm, 1934), Dr. Gustaf Ljungdahl gives an account (in English) of the origin, methods and results of the first systematic and comprehensive magnetic survey of Sweden, which was made by the Hydrographic Service in the years 1928–30. Very great care was taken in the selection of the stations (86 in number), choice being made of such as were likely to remain available indefinitely in the future for repeat observations to determine the secular variation ; also the variation of the vertical force in the neighbourhood of each station was examined by means of a Schmidt local variometer, in order that the stations adopted should be as free as is possible (in a country so magnetically disturbed as Sweden) from rapid local gradients of the magnetic field. All three magnetic elements were determined at each station using a combined magnetometer and earth inductor (Carnegie Institution of Washington type). The reduction to the mean epoch of 1929·5 was made by reference to the continuous magnetograph registrations of the Swedish observatory at Lovö, the Danish observatory at Rude Skov, and that of Finland at Sodankyla. The methods and results are fully described, and set out in tables and maps. The latter give isomagnetic lines, both 'terrestrial' (or smoothed) and 'true', and there is also a map showing the deviation of each element at each station, from the computed 'terrestrial' value.

Graphical Determination of a Flight Course. Recent research into the effect of meteorological conditions upon the performance of aircraft at considerable altitudes, carried out at the California Institute of Technology (Science Service, April 25), have resulted in the development of an extremely useful graphical method of rapidly determining the most efficient flight course for an aircraft under any given conditions. The theoretically optimum flight of an aeroplane of definite performance for a given distance can be found to consist of a combination of a period of climb at a reduced speed, followed by a prolonged gradual dive at increased speed. Full advantage of this can be taken by making use of modern developments in supercharging the aero engine and using a variable pitch airscrew, which makes it possible to maintain a desired speed at any height, within reasonable limits. The meteorological variables in this calculation are wind velocity, its change with altitude, and its angle to the course, and with the development of the technique of examining these, and the organisation for the rapid distribution of this knowledge, it has become possible to obtain it quickly and accurately enough to make use of it

previous to starting a flight. The scheme proposed by Mr. W. C. Rockefeller of the California Institute consists of a combination of charts and tables to be used systematically in such a way that the best flight path can be determined in fifteen minutes, without the necessity for any extensive knowledge of the theoretical principles involved. Thus the flight can be made in the shortest possible time, or alternatively, if working to a time table, with the lowest expenditure of power for the trip. The accuracy of the result naturally depends upon the maintenance of the assumed meteorological conditions during the flight. There are many technical reasons for limiting the time of an economic commercial flight to about 4 hours and the distance to the order of 500 miles, and within these the above assumption is reasonably correct.

Raman Spectrum of Water. I. Ramakrishna Rao (*Phil. Mag.*, June 1934) has gone over the very extensive work on the Raman spectrum of water in various phases, including some new experimental work of his own. He has compared the Raman frequencies with the infra-red frequencies and obtained some fresh light on the molecular constitution of water. The Raman spectrum of liquid water shows for each exciting line a broad band in which the author finds three maxima. The spectrum with ice showed a band with only two components, and that of water vapour shows one sharp line corresponding to the infra-red absorption band. Water of crystallisation in a number of crystals also shows one or more diffuse bands. A marked change in the Raman spectrum corresponding to the liquid-vapour transition is characteristic of polar molecules, and may be due to the interaction of molecules or to polymerisation. The three-component structure of the liquid water band is ascribed to polymerisation, and preliminary work has shown that the relative intensities of the maxima change with temperature. Thus correlation between the infra-red and Raman spectra of liquid water does not seem very certain. The frequency characteristic of the vapour molecule is entirely absent in the ice spectrum.

The Imperial Standard Yard. When Queen Elizabeth in 1584 took action which resulted in a British system of weights and measures, the most accurate method of comparing lengths was by beam compasses, and the Exchequer yard was an end standard. The micrometer microscope made the distance apart of fine lines a more accurate measurement, and the reconstructed Imperial standard yard of 1855 was defined as the distance apart of two fine lines on two gold plugs near the ends of a certain bronze bar at 62° F. Messrs. Sears and Barrell, of the National Physical Laboratory, have been engaged for several years in determining the yard in terms of the wave-length of the red cadmium line in vacuum, and their methods and results are embodied in two memoirs in the *Transactions of the Royal Society*, vols. A, 231 and 233. Two tubes of invar about 10 cm. long are closed at each end by half silvered glass plates, and the distances apart of the silvered surfaces determined in terms of the wave-length. One of these tubes is then compared in length with one of 33 cm. length by placing them in series and obtaining Brewster's fringes. The 33 cm. tube is then compared by the same means with one about a yard long. The final result is that the Imperial standard yard is 1,419,818·31 wave-lengths of the red cadmium line in vacuum. The value obtained by Dr. A. E. H. Tutton in 1931, and published in his *Phil. Trans.* paper in that year, was 1,420,209·8 wave-lengths.

Isomers of Carotene. From the annual report of the Carnegie Institution of Washington, Year Book No. 22, 1933, it would appear that an active attack upon the complex problems presented by the yellow leaf pigments is continuing in the Division of Plant Biology under the general direction of Dr. H. A. Spoehr. It is now clear that at least two isomers of carotene are usually present in the plant source, α-carotene, characterised by its optical activity, and β-carotene, which is optically inactive. The carotene prepared from leaf sources by the Carnegie workers has always been the optically inactive form, though leaf sources for optically active carotene have been found by Japanese and German workers. Dr. Smith has succeeded in preparing a highly purified preparation of α-carotene from the carotene mixture obtained from carrots. His method consisted mainly in the differential absorption of the optically inactive form by a mixture of 'norit' and siliceous earth, after this had been previously heated to 500° C. *in vacuo* and then allowed to cool in an atmosphere of nitrogen or carbon dioxide. The absorption spectra, solubilities, etc., of both isomers are under study and some evidence has been found of the presence of yet another yellow component, though as a rule the behaviour of the pigment extracts is compatible with the existence of two components in solid solution. A further study of the degree of unsaturation confirms earlier work, and every form of carotene appears to absorb eleven molecules of hydrogen per one molecule of pigment. These studies are of vital importance in view of the significance of carotene in vitamin studies.

Spectra of Wolf Rayet Stars and Novæ. Observations of the contours of emission bands in the spectra of Wolf Rayet stars and novæ have been made by C. S. Beals (*Pub. Dom. Astrophysical Obs.*, 7, No. 9) with the view of testing the author's theory of the origin of these bands. This theory assumes the continuous ejection of atoms from the surface of a star, and will explain any symmetrical band contours by postulating a suitable frequency distribution of ejected atoms. Flat-topped contours would result when there are no velocities in the vicinity of zero. The author gives a useful account of the method of calibrating stellar plates for spectrophotometric purposes by means of a neutral tint absorbing wedge placed in front of the slit of a spectrograph, and also of a new type of microphotometer used for the intensity measurements. The results show that flat-topped bands are present in the spectra of Nova Aquilæ and Nova Cygni, but in the case of Wolf Rayet stars such contours are exceptional, indicating a very different frequency distribution of the ejected matter. An important by-product of this investigation is the advance made in the classification of Wolf Rayet stars, through the measurements of total intensities in 64 emission bands. It appears that they may be divided into two sequences, called the 'Carbon Sequence' and the 'Nitrogen Sequence'. These are approximately parallel (as regards ionisation level) and the presence of both neutral and ionised helium in each of them has hitherto masked their separate character. The intensities are also used in a brief discussion of the temperatures, using Zanstra's method. Approximate values of 50,000°–100,000° are obtained for Wolf Rayet stars, 65,000° for Nova Aquilæ, and 20,000° for *P* Cygni.

The Atmospheres of the Giant Planets

By DR. ARTHUR ADEL and DR. V. M. SLIPHER, Lowell Observatory and the University of Michigan

THE present paper is concerned with the results of an investigation carried out to ascertain the extent to which the methane molecule (CH_4) is responsible for the spectrum of the major planets.

In order to secure intensities of absorption comparable with those obtained in the planets, a path-length of two thousand metre-atmospheres was employed. The spectrum of a source of continuous radiation shining through the gas was secured with a glass Hilger *E*-I spectrograph, and the photographs cover the region from the violet to the infra-red.

A survey of the band spectrum of gaseous methane is above all characterised by the prominent overtone sequence of the ν_3 fundamental at $3 \cdot 3\mu$. This sequence coincides precisely with the outstanding group of absorption bands in the spectra of the giant planets. The latter is shown in Fig. 1, in which the series of bands $5\nu_3$, $6\nu_3$, $7\nu_3$ and $8\nu_3$ are immediately discernible. It is especially gratifying to observe that the band which is superimposed upon H_β is included amongst the members of this group.

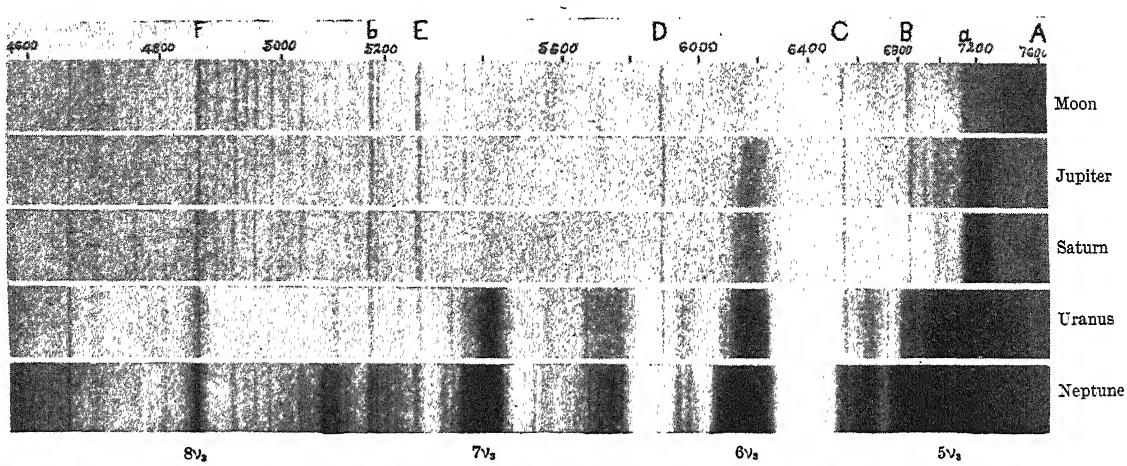

FIG. 1. Spectra of the giant planets.

The harmonic nature of the above sequence is nicely displayed by the curve of Fig. 2. Extrapolation shows that planetary absorption may be expected at about 4410 A. (extremely weak) and at about 11,540 A. (extremely intense). The 4410 A. band is with very little doubt to be identified as the Neptune band reported by Slipher[1] at 441mμ. This is the ninth harmonic of ν_3, and Neptune alone amongst the major planets has sufficient methane in the absorbing layers of its atmosphere to register it.

In virtue of the fact that this sequence of rotation-vibration bands is the most prominent in the entire band spectrum of the molecule, it is to be expected that its members will combine with the other fundamental vibrations ($\nu_1 = 2{,}915$ cm.$^{-1}$, $\nu_2 = 1{,}520$ cm.$^{-1}$, $\nu_4 = 1{,}304$ cm.$^{-1}$) in the production of the system of absorption bands $n\nu_3 + \nu_i$, where i may equal 1, 2 or 4; and that these bands will be amongst the next strongest in the spectrum. This is indeed the case, for the bands which appear in the laboratory and planetary spectra of methane (other than the group $n\nu_3$) are for the most part members of this system of combination bands. Not all of the methane bands showing in the spectrum of the outer planets have as yet been detected in the laboratory, however, inasmuch as the absorption columns in Neptune and Uranus are an order of magnitude greater than the laboratory path-length described above. In conformity with expectation, the planetary bands of the type $n\nu_3 + \nu_i$ which have been duplicated in the laboratory involve the smaller values of n. The present absence of complete duplication is, of course, no obstacle to the identification of the planetary bands. The fact that there exist but four normal modes of vibration of the methane molecule, and that the selection rules governing the band spectrum prohibit the appearance of the frequencies $p\nu_1 + q\nu_2$, means that there is a minimum of overlapping in the consequential spectral regions, and therefore but very small uncertainty in the correlation. The astronomical data employed in the analysis are those of the extensive investigations of V. M. Slipher of the Lowell Observatory. Reference should be made to the *Lowell Observatory Bulletins*, and the *Monthly Notices of the Royal Astronomical Society* for descriptions and illustrations of the absorption bands in the remarkable spectra of the giant planets[2]. The spectrum has been recorded into the infra-red as far as 10,000 A.[3].

In the identification given below, the bands which have thus far been duplicated in the laboratory are followed by asterisks.

Identification of the Planetary Methane Bands of the Type $n\nu_3$

n	4	5	6	7	8	9
Band position (mμ)	886*	725*	619*	543*	486*	441

Identification of the Planetary Methane Bands of the Type $n\nu_3 + \nu_i$

$i = 1$	n	3	4	5	6
	Band position (mμ)	861*	702*	595	521
$i = 2$	n	4	5	6	
	Band position (mμ)	782*	656	568	
$i = 4$	n	5	6	7	8
	Band position (mμ)	668*	576	509	459–460

ν_4 is a very low frequency oscillation, and therefore

only its high harmonics will invade the photographic region of the spectrum. Consequently, we should expect the methane bands $m\nu_4$ in the planets to be weak ones. This is indeed the case. The harmonic nature of the sequence is strikingly brought out in Fig. 3.

Identification of the Planetary Methane Bands of the Type $n\nu_4$

n	9	10	11	12	13	14	15
Band position (mμ)	874*	788*	720*	662*	614	on blue edge of $6\nu_3 + \nu_4$	534

An idea of the complexity of the fine structures of the methane absorption bands may be gained

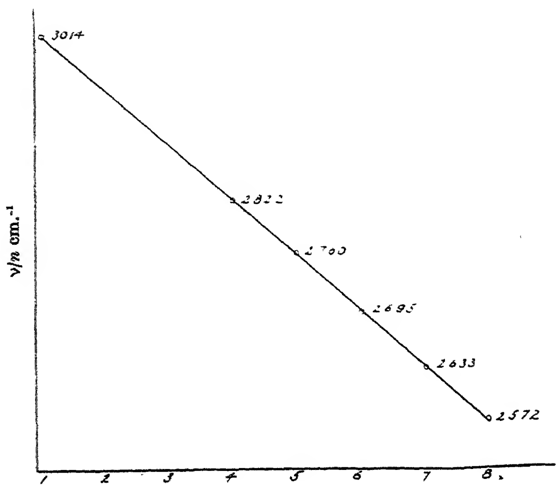

FIG. 2.

from the following examination of the harmonics of ν_3.

The ν_3 mode of vibration of the methane molecule possesses three degrees of freedom. An analysis by Dennison and Ingram[4] based upon this fact in conjunction with the tetrahedral symmetry of the molecular force field has shown that the vibrational energy levels $n\nu_3$ are multiple with a multiplet separation which is very small in comparison with the fundamental frequency; in fact, of the same order of magnitude as the rotational structure. Thus, when n is the order of the harmonic, approximately $\frac{1}{2}(n + 1)(n + 2)$ bands superpose to form a single composite absorption band $n\nu_3$. Consequently, such a band as the $7\nu_3$ one in the planets is actually a superposition of some eighteen bands. It is not surprising, therefore, when such a band proves difficult of resolution.

A predominantly hydrocarbon nature seems not at all unlikely for the giant planets. Aside from the above very probable identification of methane, this conclusion is also indicated by the fact that the mean densities of the giants are in a class with the densities of most organic liquids. Furthermore, it is not surprising that methane should stand out so prominently, inasmuch as its vapour pressure at the extremely low temperatures which prevail in the atmospheres of the outer planets is far in excess of the vapour pressures of any of the other hydrocarbons apt to exist there.

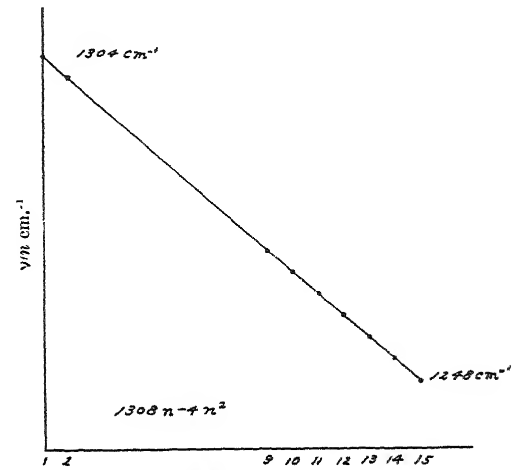

FIG. 3.

It is a curious and noteworthy fact that the two constituents, of the existence of which in the planetary atmospheres we are now fairly certain, namely, methane and ammonia, are saturated with hydrogen. This fact, taken in conjunction with the very stable natures of these two compounds, may signify that collision reactions in the atmospheres of the giant planets have continued over vast periods of time in a progression of the atmospheric constituents towards maximum stability relative to the physical conditions which prevail in the planetary atmospheres.

[1] *Lowell Obs. Bull.*, No. 42.
[2] *Mon. Not. Roy. Ast. Soc.*, **93**, No. 9; 1933.
[3] *Mon. Not. Roy. Ast. Soc.*, **93**, No. 9, Plate 15, Fig. 3; 1933.
[4] *Phys. Rev.*, **36**, 1451; 1930.

Scientific Studies of Noise*

THE subject of noise control is being actively studied scientifically at the U.S. Bureau of Standards, the Heinrich Hertz Institute in Berlin, and at the National Physical Laboratory in Great Britain, while a number of firms have developed noise-measuring apparatus, means for reducing noise-levels, and materials and methods for isolating vibration. Literature tells us that the noise problem is by no means new, but in addition to the old sources of noise, civilisation brings in new sources; there is evidence of a growing noise-consciousness in the public, possibly due to increased nerve strain and reduced tolerance, and increased sense of the social value of noise reduction.

The problem is being considered by a Committee of the British Standards Institution, with the view of arriving at an acceptable definition of noise and methods of measurement.

From the general point of view, any type of noise may annoy someone, the nuisance value depending on the marginal or 'last straw' effect, the latter being largely personal. Although considerable noise can be tolerated, particularly when self-generated, Bartlett is of the opinion that the cumulative effect of some slight adjustments by a worker may in time produce

* Summary of an address delivered by Dr. G. W. C. Kaye, superintendent of the Physics Department, National Physical Laboratory, before the Science and Noise Section of the Conference of the Anti-Noise League held at Oxford on July 14.

fatigue of industrial significance. The Industrial Health Research Board recently obtained evidence of the effect of a noisy environment on industrial output. Thus, weavers gave a significantly higher output when provided with ear defenders; and a similar result was obtained with typists using noiseless typewriters. In addition, there are many examples of noise, depending on time and place, which offend the great mass of people. Scientific investigation can here form the basis of legal control, if desired by an enlightened public.

The scientific measurement of the minute acoustic power which appears as a loud noise is greatly assisted by microphone and amplifier technique. The loudness scale is taken as a logarithmic scale, with the decibel as the unit, with a zero-level of the order of 0·3 milli-dyne per sq. cm., which will probably be internationally fixed in the near future. For a specified noise to be measured, it is compared with an adjustable standard tone, a pure 1,000 cycle-per-second note. In Germany, the unit of loudness of the standard tone is called the phon; it is suggested that this unit be generally adopted, restricting the decibel unit to purely intensity measurements or levels.

The two main methods of comparing a specified noise with the controllable standard noise are (1) the objective measurement, with microphone, amplifier, and indicator, and (2) the subjective measurement of loudness by audiometers, using matching or masking of the noise with the standard tone, employing the ear as the indicator.

The objective methods require calibration against absolute standards, such as the Rayleigh disc. Correcting networks are required for the non-uniform response of the system with frequency, and weighting networks are required for the simulation of the differential frequency sensitivity of the ear. The objective method is well suited for the rapid estimation of noises of similar type. Objective meters also permit a ready demonstration of the component frequencies in a sound, thus permitting the source of specified frequencies to be traced and controlled.

Subjective methods, by masking or matching, are likely to be standardised between the leading countries, the balancing to be done with both ears, with the observer facing the source of sound. Such methods require trained observers for uniform results. It has been noticed that the adjustment with audiometers should be from the loud side, rather than the reverse, or both. Audiometers are not well adapted for short-period or fluctuating noises. A simple type of audiometer is a tuning fork, struck in a specified manner, and having a known rate of decay.

Surveys have recently been made by the National Physical Laboratory. Ordinary conversation registers about 50 decibels, a tube train about 80, while the loudest sounds, such as from riveting, pneumatic road-drills, steamship sirens, printing presses and aeroplane engines, are represented by figures up to 110 decibels. Traffic noises arise from the increase in the number of vehicles and narrow streets, though there is some evidence that the average vehicle is quieter than a few years ago. The modern bus and trolley-bus are great improvements over the older bus and tram. The introduction of pneumatic tyres on heavy vehicles is a commendable step. Noise, then, no longer comes from the road surface, but mainly from the transmission and exhaust, which are controllable. Noisy hooters and the modern sports car are major factors in the generation of traffic noise, many flouting the law (Traffic Act, 1930) on the score of ineffective engine silencing. Motor cycles are major offenders; developments have shown that real silencers can be fitted as a first step in reducing the total noise, the design depending on acoustic filtration of the generated frequencies.

National Physical Laboratory trials with motor horns support the view that stridency is related to the presence of loud high-frequency components. Hooting is to be regulated. Abroad, many cities have adopted nocturnal freedom from hooting.

In the control of noise-levels, industry as a whole seems to be becoming active, since the welfare of the worker is involved. Much has been done in aircraft silencing, particularly in the cabins, by the improved disposition of the engines and the use of isolating wall construction. In the field of quiet housing, new equipment has been installed at the National Physical Laboratory for the systematic investigation of building materials.

The Forests of Kenya

THE annual report of the Forest Department of the Protectorate and Colony of Kenya up to December 31, 1932 (Govt. Printer, Nairobi, 1933) reflects the present position of most of the forest departments of the Protectorates and Colonies under the Colonial Office. The report opens with the sentence, "The world-wide economic depression continued to affect the Colony and to an even more serious extent than in the previous year, with the result that revenue continued to decrease and further economies became essential". It is of course unavoidable that the heads of the forest departments should concern themselves primarily, even at the expense of professional practice, with the revenue receipts from the forests under their charge. For it is apparent that certain of the governors and their advisers are only able to envisage the forests and a forest policy from the point of view of the monetary return that can be extracted from the forest estate.

As is well known, in countries in Europe where a forest policy and forest administration have for long been working hand in hand, those responsible for the professional management of the forests assume that revenue shall exceed expenditure, and that the department shall be one of the revenue resources of the State. In the case of ill-developed areas of forest with considerable potential possibilities, the effort to obtain revenue at the expense of real efficiency is, in the long run, inevitably disastrous.

Kenya is not the only Colony which is now suffering from a similar policy. In the immediate post-War years (if we omit the pre-War period and possibility of development in some Colonies) a broad forest policy coupled with a bold expenditure devoted to enumerations of the growing stock of unexplored forest areas and opening out the most accessible ones, would have assuredly placed the various forest departments on a sounder basis, and have enabled them to withstand better the depression of the last few years. The vacillating policy adopted left the departments in the most cases undermanned and weak, with the result that they have suffered probably to a greater

degree from the severe cuts in establishment and so forth which have been their lot during the past few years—an action which will delay the development of the valuable forest estates under their control, and the consequent revenue to be derived from these estates, by a decade.

This being the position of affairs, it is not surprising to find the Conservator of Forests of Kenya devoting the opening paragraphs of his report to the financial position of his Department.

The Kenya forests are probably, in the interests of the economic development of the Colony, of so great a value that the statement that expenditure was reduced to £31,691 as compared with £36,237 in the previous year and that the cash revenue was £26,156, showing a deficit of £5,353, appears of trivial importance; when the far graver issues dependent upon the maintenance and correct management of this valuable property are taken into consideration.

It seems clear from the report that the drop in timber sales is only a temporary matter and that the normal requirements of the Colony will in due course witness a rise.

Owing to shortage of staff and the orders to economise, the area replanted, although said to be equal to the area felled during the year, showed a decrease on the preceding year's acreage, being 3,892 acres as against 4,756 acres in 1931 and 4,429 acres in 1930.

In spite of troubles brought about by irregular rainfall and locusts—the Colony has experienced bad invasions of this pest for several years past—it was estimated at the end of the year that 73 per cent of the area planted was completely established, 26 per cent was fair and 1 per cent only had failed—a record sufficient to satisfy the most ardent planter. Improved organisation and increased economy of working is shown in this planting work, the average cost falling from 8·86*s*. to 7·13*s*.; this figure includes the cost of work in 1931 in preparation for the 1932 planting but does not include supervision or nursery costs.

The Conservator appears to be concerned with the timber being cut in the small forests still existing on private land which "was often sold for anything it would fetch and had a most demoralising effect on the timber market". In the early days in India, when Sir Dietrich Brandis was introducing a forest management and selecting reserves, he regarded the felling of timber on the private estate as assisting in providing for market requirements. His view was that these operations were an assistance to the State since it allowed the forest officer time to consolidate his selected areas of forest and to introduce an effective system of management. But at the time, it was recognised that some forest divisions or conservators' charges could not be expected to yield a revenue until effective organisation had been introduced, and the cheap material on private lands had been exploited and had disappeared.

International Congress for Applied Mechanics

Cambridge Meeting

The fourth International Congress for Applied Mechanics was held in Cambridge under the presidency of Prof. C. E. Inglis on July 3–9. About 320 members attended, including representatives of twenty-three countries. More than 140 papers were read, in four sections dealing respectively with general mechanics, hydrodynamics, strength and properties of materials, water waves.

Besides these sectional papers, seven general lectures were delivered by invitation describing recent progress in some of the main fields of science covered by the Congress. The general lecturers were Prof. V. Bush on analysing machines, Prof. A. Caquot on the elastic limit in isotropic materials (in French), Prof. J. P. den Hartog on vibrations in engineering, Prof. Th. v. Kármán on turbulence, Prof. E. Schmidt on heat transference (in German), Prof. G. I. Taylor on the strength of crystals, Prof. H. Wagner on bodies gliding on the surface of water (in German). This list gives some idea, though by no means a complete one, of the range of subjects covered by the Congress.

The subject which perhaps attracted the greatest amount of attention was turbulence in fluids. There were present at the Congress most of the principal workers in the subject in the world. Prof. L. Prandtl spoke on the application of the laws of turbulent flow to the general circulation of the atmosphere. Dr. Schlichting gave an account of experiments at Göttingen on flow through a tunnel which was heated from above so that turbulence was reduced owing to a stable gradient of density. Dr. H. L. Dryden and Mr. Waltendorf spoke of measurements of turbulence made with hot wires at the Bureau of Standards, Washington, and at Pasadena. From the National Physical Laboratory, Teddington, Mr. A. Fage described his measurements of turbulence by an ultramicroscope; Mr. H. C. H. Townend, measurements by observing the motion of spots of air heated by a succession of sparks; and Mr. E. F. Relf, the effects of turbulence on force measurements made in the new compressed air wind tunnel. From Cambridge, Prof. B. M. Jones described measurements made on an aeroplane in flight of the region behind the wing where the flow is turbulent. From the laboratories of Prof. H. Benard and Prof. D. Riabonshinsky in Paris, work on vortices in fluids was described.

Owing to the large number of the scientific papers presented, it was impossible to publish them in full. In most cases they have been, or will be, published elsewhere, but abstracts were printed for the use of members at the meetings, and these will be reprinted in a volume which will also contain the seven general lectures, printed in full, and a short general account of the Congress. This volume, costing £1, will be ready in a few months' time and will be obtainable from the Secretary, Fourth International Congress for Applied Mechanics, Engineering Laboratory, Cambridge.

The Congress was entertained at evening receptions by the Mayor of Cambridge and by St. John's College, at a conversazione and exhibition of instruments and demonstrations by the Engineering Laboratory, at a garden party by Christ's College, at dinner by the Organising Committee and Trinity College and afterwards by Sir J. J. and Lady Thomson, and by the Provost of King's at a concert.

International Congresses for Applied Mechanics are held every four years. The first three were at Delft, Zurich and Stockholm, respectively. The fourth was at Cambridge, England, and the fifth will be held in 1938 at Cambridge, Massachusetts, under the auspices of Harvard University and the Massachusetts Institute of Technology.

Habitat Selection in Birds

THE afforestation of the Breckland heath with young pines provided David Lack (*J. Animal Ecol.*, Nov. 1933) with the opportunity of studying the changes in avifauna. Until the trees are some four years old, only the heathland birds occur, but within the next five years these disappear and are replaced by a new avifauna. The most marked features are the steady decrease of the skylark and the meadow pipit, and the appearance and rapid increase of the willow warbler.

Deficiency of nesting sites explains a few changes in the distributions ;. thus the wheatear, common on open heaths and nesting exclusively in rabbit burrows, does not occur in afforested areas, which are rabbit-proof. Food, though clearly important in controlling the total bird population, does not appear to limit the distribution of any species investigated. The question of enemies can be ruled out, since man has destroyed almost all bird and egg-eating animals of the district. The most important appears to be the psychological factor, which is emphasised by the absence of certain species from areas, otherwise suitable, which do not supply them with a singing perch. Thus the requirements of the meadow pipit and the tree pipit are the same, but the latter occurs only in localities with fairly tall trees, or even in places with a single tree. Often, in the cases of closely related species, there appears nothing in the environment to cause the difference in distribution, and the remaining possibility is again the psychological factor.

When instinct appears to control such complex matters as nest building, it would be surprising if it did not control the type of ground selected by a bird for a breeding territory. The psychological nature of this instinctive habitat selection is often indicated by the fact that the height and not the nature of the vegetation is the determining factor. At times birds may successfully break away from the ancestral habitat.

Habitat selection may have some bearing on evolution. It is known that the passerine species of the north temperate region tend to occupy distinct but adjoining habitats, affording the same essential requirements, but differing in conspicuous features. Perhaps in this way two groups become isolated and eventually split into two species, as in the case of the meadow and the tree pipits.

University and Educational Intelligence

CAMBRIDGE.—The Michael Foster studentship, offered annually for the encouragement of research in physiology, valued at 100 guineas, has been awarded to C. M. Fletcher, of Trinity College. The Wrenbury scholarship for study and research in economics, valued at £100, has been awarded to R. B. Bryce, of the University of Toronto and St. John's College.

At Clare College, the following elections to research studentships have been made: minor research studentship of £100 for two years, A. Marriage; Denman Baynes studentship of £50 for one year for chemistry, R. M. Barrer; Denman Baynes studentship of £50 for one year for physics, B. M. Crowther; reearch studentship of £50 for chemistry, I. Kemp.

EDINBURGH.—At the graduation ceremonial on July 18 the Cameron Prize in practical therapeutics was awarded to Sir E. Sharpey-Schafer, emeritus professor in the University, in recognition of the advances in therapeutics arising out of his discoveries in endocrinology.

LEEDS.—Mrs. Bolton has presented to the University a telescope and other scientific instruments belonging to her late son, Mr. Scriven Bolton, of Bramley, who began his astronomical career at the University Observatory.

Mr. K. Mitchell has been appointed assistant lecturer in applied mathematics as from the beginning of next session.

LONDON.—The University has received from the Carnegie Corporation of New York an offer to provide 22,500 dollars annually for three years to aid the Institute of Education in developing its relations with students from the Dominions and Colonies. The sum is intended to provide fellowships for short periods to selected students from the Dominions, and to enable the Institute to invite a senior university teacher from one of the Dominions to hold for a limited period the post of adviser to overseas students.

The following appointments have been made :—University chair of pharmacology (University College) (from July 1, 1935), Prof. J. H. Gaddum, since January, 1934, professor of pharmacology in the Egyptian University, Cairo. University chair of chemical pathology (London Hospital Medical College) (from October 1, 1934), Dr. J. R. Marrack, since 1919, lecturer in chemical pathology at the London Hospital Medical College. University readership in anthropology (London School of Economics) (from October 1, 1934), Dr. Raymond W. Firth, since 1933, lecturer in anthropology at the London School of Economics.

Proposals for the establishment of an Institute of Archæology, and for its scheme of management, have been approved by the Senate, and Dr. R. E. Mortimer Wheeler has been appointed honorary director of the Institute.

BILINGUALISM presents educational problems in various parts of the world which have been dealt with in various ways, determined in not a few instances more by political than by purely educational considerations. In the United States, these problems have to some extent been solved or cut through by 'Americanisation' schemes. In general, the view has prevailed that children speaking a foreign language should be put as early as may be into school and, in so far as is possible, speak English only during the entire day. The use of the vernacular as a medium of education has been attempted experimentally at the San José School, which was reorganised as a training school for the use of the Education Department of the University of New Mexico in 1930, as part of a five-year programme of research in methods of education for Spanish-speaking pupils. Some account of this undertaking is given in *Bulletin* No. 11 of 1933 of the United States Office of Education, which reviews the whole subject of "The Education of Spanish-speaking Children in five South-Western States". This question has assumed in recent years a growing importance due to the rapid increase in these States of people of Mexican stock, the percentage of whom to the total population has increased from 1·9 in 1900 to 4·2 in 1910 and 9·6 in 1930.

Science News a Century Ago

Royal Geographical Society: Early Exploration Efforts

During the summer of 1833 the Council of the Royal Geographical Society had been actively engaged in promoting, with the countenance and patronage of His Majesty's Government, two exploring expeditions, leaving England, it was contemplated, in July of the following year, or near that date. The first of these was an expedition of discovery in South Africa by means of exploration up one of the rivers falling into Delagoa Bay. With the approval of the Society (which was chargeable with much of the expense) the task was entrusted to Capt. James Alexander, an adventurous young officer who in after life achieved much national fame. What sum of knowledge resulted from the project is a story revealing the uncertainties attending early geographical effort, however well planned in advance. The honorary secretary to the committee appointed to organise the expedition was Mr. W. Desborough Cooley, a fellow, and sometime first secretary, of the Hakluyt Society. In the opinion of Dr. H. R. Mill ("Record", Roy. Geog. Soc., 1930), Mr. Cooley was "an erratic genius". He had never, Mill tells us, travelled, but supported himself by writing about all parts of the earth. Devoting himself mainly to Africa, Mr. Cooley recorded and criticised the work of explorers, whilst upholding fantastic theories of the geography of the continent, even against the assertions of those who had actually traversed various tracts. However, much kindly appreciation was entertained finally, the Society securing for him a Civil List pension of £100, terminated in 1883 by his death.

The second of the two expeditions arose from the offer of Richard (afterwards Sir) Schomburgk, who proposed to explore the interior of British Guiana, with the financial assistance of the Society. A committee accepted his services, and following a strong appeal to the Government, a contributory sum was voted for the expedition, as well as for the Delagoa Bay project. Schomburgk's work proved to be of great geographical and botanical service.

Elcot Park Garden: Heating Hot-houses

"This place is celebrated as the scene in which the mode of heating hot-houses by hot water was displayed, in 1823, to the British public; we will not say for the first time, because we have shown that it was exhibited in the hot-houses at Sundridge Park, by the Count Chabannes, in 1816; but we do say that it was from the apparatus displayed in this garden that this mode of heating first became generally known to the British public. We also believe that the late Mr. Bacon invented it at Aberaman in 1821, as Mr. Atkinson appears to have done in London in 1822. There is nothing uncommon in different persons inventing the same thing at nearly the same time, without any knowledge of each other's ideas. Inventions are more commonly results of the general state of science on a particular subject, at a given time, than of the character or degree of knowledge of an individual mind." (J. C. Loudon, *Gardener's Mag.*, July 1834.)

Abolition of Slavery in British Colonies

As a result of an Act of Parliament passed on August 28, 1833, for the abolition of slavery in the British Colonies, for the promotion of industry among the manumitted slaves and for the compensation of slave-holders, on August 1, 1834, nearly 800,000 negro men, women and children in Jamaica, Barbadoes, Trinidad, Mauritius, South Africa and other places obtained their freedom. Thus culminated the self-denying efforts of a comparatively small group of men, who for half a century had advocated the claims of these unfortunate people. The event was commemorated with great rejoicings, many meetings were held in Great Britain, and on the day referred to the friends of the abolition of slavery held a dinner at the Freemason's Tavern, London, which was presided over by the Earl of Mulgrave, who for two years had been Governor of Jamaica in which were more than 300,000 slaves. In a speech on the occasion, he told how that as soon as it was known that the British Legislature had given emancipation to the black population he made a tour of the island to explain to the negroes the nature and the extent of the boon they had received. He was convinced, he said, that there was nothing in the negro mind to unfit it for the reception of moral and religious instruction, and he hoped the negro population of our Colonies would fulfil all the hopes and expectations of those who had so nobly stood forward to assert their rights, and raised them from the degradation of slavery to the proud elevation of British subjects.

Meteorological Records for 1834

An interesting article on meteorology in the *Athenæum* of August 2, 1834, began: "The daily increasing interest that is felt in Meteorological Observations, the high rank that they have of late assumed in this department of physical science, the importance of the results which may be obtained from them by a cautious system of induction, and the absolute necessity, before such results can be announced as general principles, that the observations on which they are founded should be numerous, accurate and authentic, have rendered us for some time more than ordinarily anxious to meet the demand for information, in a manner at once full and satisfactory; and our readers will learn with pleasure that our exertions have been crowned with the highest success, in proof of which we this day present them *The Meteorological Journal* kept by order of the President and Council of the Royal Society, at their apartments in Somerset House." The number of August 2 accordingly contained the Meteorological Tables for the months of January–June 1834. Succeeding Tables were published monthly.

The Entomological Society

On August 4, 1834, at a meeting of the Entomological Society, presided over by Lieut.-Col. W. H. Sykes (1790–1872), a report of a committee for investigating the nature of the ravages of the cane fly was read. The matter had been brought before the Society on July 7, when it was said that this insect, a minute species of the Cicada of Linnæus, was committing incredible mischief in Grenada and other West Indian Islands, having in some cases destroyed not less than two-thirds of the crops. A committee was therefore appointed to discover the precise mode of its attack, and if possible to suggest a remedy. In the report, a variety of suggestions were made and these were immediately forwarded to the Agricultural Society of Grenada. At the same meeting, Col. Sykes described some species of Indian ants.

Societies and Academies

DUBLIN

Royal Dublin Society, May 29. E. J. SHEEHY: Derangement of the digestive processes in the milk-fed calf, due to abnormal curd formation in the fourth stomach. The accumulation of dense curd in the fourth stomach which frequently causes ill-health and mortality among pail-fed calves may be successfully prevented and treated by the dilution of the milk diet with water. J. H. J. POOLE: A convenient method of measuring resistances of the order of 10^{12} ohms with a ballistic galvanometer. The rather obvious method of measuring the small current passing through the given resistance under a P.D. of a few hundred volts by means of a condenser and a ballistic galvanometer does not appear to be generally known. By allowing this current to charge the condenser for any convenient time, and then discharging it through the galvanometer, currents may be measured far below the limit of the same galvanometer for steady currents. Any well-insulated condenser will suit, since the P.D. across it never exceeds a fraction of a volt. This method, which allows very small currents to be measured with simple and comparatively robust apparatus, would also appear to be well suited for use with photoelectric cells in certain cases. T. J. NOLAN, J. KEANE, M. CASSIDY, N. E. DOLAN: The chemical constituents of lichens found in Ireland (1). The lung lichen, *Lobaria pulmonaria*, collected in the Powerscourt Demesne, Co. Wicklow, was found to contain two constituents, a neutral substance which has been identified as *d*-arabitol, and a lichen acid to which the formula $C_{18}H_{14}O_9$ is given. The acid contains one methoxyl group. T. J. NOLAN: The chemical constituents of lichens found in Ireland (2). The lichen *Buellia canescens* gathered in Killiney, Co. Dublin, is found to contain at least two materials. One of these is diploicin, previously found by Zopf in the same lichen. Diploicin contains chlorine, contains no methoxyl group, is not reduced by hydriodic acid, forms an acetate, and with alcoholic ammonia gives a product containing one nitrogen atom. The second product, m.p. 196° C., which was described by Zopf as atronorin, is not atronorin; it contains no methoxyl group. H. H. JEFFCOTT: The approximate determination of the vibration of beams and the whirling of shafts. Comparatively simple tabular and graphical methods have been worked out for finding by successive approximations the deflections of beams under moving and vibrating loads, including the effect of inertia and damping forces. Similar methods are used for finding the whirling speeds of shafts. Report of the Irish Radium Committee for the year 1933: The report includes detailed statements submitted by some of the largest users of radon supplied by the Committee, giving particulars of the treatment of 466 cases of disease, both malignant and non-malignant, during the year 1933.

PARIS

Academy of Sciences, June 4 (*C.R.*, 198, 1953–2032). R. FOSSE, P. E. THOMAS and P. DE GRAEVE: Dextrorotatory allantoin. Its presence in the vegetable kingdom (*Platanus orientalis*). Using a method of extraction in which all rise of temperature is avoided, the authors have isolated for the first time dextrorotatory allantoin: this readily takes the racemic form. J. COSTANTIN: The problem of the rust of wheat, and mountains. A discussion of the probability of growing wheat at high altitudes lessening the tendency to develop rust. GEORGES CLAUDE: The treatment of air with the view of extracting krypton and xenon as essential products, and on the application of these gases to incandescent lamps. An apparatus has been constructed treating 800 cubic metres of air per hour, capable of collecting 2/3 of the total krypton and xenon. An electric light bulb containing krypton instead of argon stood 100 per cent over-voltage without appreciable heating. LUCIEN DANIEL: Variations of seedlings of *Helianthus Dangeardi* at the seventh sexual generation. J. DIEUDONNÉ: The zeros of the derivative of a rational fraction. J. LE ROUX: Systems of co-ordinates transformable by the Lorentz group. PIERRE LANGLADE. Helicoidal gears. J. GRIALOU: Certain fluid movements. A. LAFAY: The effect of vortices transported by the wind. In wind-channel experiments, marked differences in stability were found according as the air was drawn from the outside air or used again after circulation. The cause of this difference was traced to the existence of eddies. TCHANG TE-LOU: The instability of the indicator diagram and the composition of the combustible mixture. R. TREMBLOT: The spectrum and orbit of the double stars Auriga. From spectroscopic observations on this double star the duration of the eclipse was deduced as 40 days and the radius of the star *K*5 as at least 208 times that of the sun. L. LOISEAU: The general equations of mechanics and electromagnetism. L. BOUCHET: The detection of damped Hertzian waves by a dry battery with a solid radioactive electrolyte and ionised air. ST. PROCOPIU and T. FARCAS: The Curie ferromagnetic point for thin layers of nickel, electrolytically deposited. The Curie point is higher for thin layers of nickel, the average increase being 17° C. YEU KI HENG: Certain compounds of tartramide and of tartramic acid. Description of reactions with ammonium molybdate, alkaline borates, copper hydroxide, aluminium hydroxide. JEAN BECQUEREL, W. J. DE HAAS and J. VAN DEN HANDEL: The paramagnetic rotatory power of siderose. Measurements were made at temperatures 14·13 K, 15·95 K, 17·98 K and 20·36 K on two specimens of siderose from different sources. The variations between the two minerals are large. R. SCHWOB: The velocity of detonation of solid explosives. E. CANALS and P. PEYROT: The fluorescence of some pure substances. Data are given for some thirty organic compounds, the fluorescence being referred to water as a standard. Some hydrocarbons (hexane, benzene, toluene, xylenes) show no fluorescence: all the oxygen compounds examined were fluorescent, as also were the cyclanes and their derivatives. F. FRANÇOIS: The preparation of antimony iodosulphide in the wet way. Description of the preparation and properties of SbSI. MLLE. R. MENDES DA COSTA: Stereomutation and absorption of the β-anisylacrylic acids. A. E. FAVORSKY and MME. T. I. TEMNIKOWA: The reciprocal transpositions of methylbenzoylcarbinol and of phenylacetylcarbinol. A case of a new keto-anolic tautomerism. The new type of tautomerism studied is distinguished by the simultaneous migration of two atoms of hydrogen instead of one in the usual type, and is named anolic instead of enolic. MARCEL GODCHOT and MAX MOUSSERON: The passage from one ring to another by the deamination of 2-aminocyclanols. Nitrous acid, reacting with 2-aminocyclohexanol at 0° C., gives cyclopentyl-

formaldehyde: cyclohexylformaldehyde is formed by a similar reaction. CHARLES COURTOT and IZAAK KELNER: The existence of privileged substitution positions in diphenylene sulphide. R. PERRIN: Metamorphism. An application of the known changes occurring in slags during contact with the furnace walls to geological phenomena. ALBERT F. DE LAPPARENT: The trend of the Rognette synclinal. LOUIS BESSON: The influence of temperature and season on mortality. The number of deaths due to diseases of the respiratory organs in Paris is at a maximum in February, March and passes through a minimum in August. PIERRE CHOUARD: The characteristic structure of the bulb in *Scilla*, section *Euscilla*. Confirmation of the value of the method of classifying bulbous plants by the mode of growth of the bulb. J. CHAZE and M. M. JANOT: The chemical characterisation of the volatile alkaloids emitted by the hemlock. Definite proof of the emission of conine vapour from hemlock. J. BEAUVERIE: The individual resistance of micro-organisms, yeasts in particular, to ultra-violet radiations. MICHEL FLANZY: The presence of methyl alcohol in alcohols from wine, marc and fruit. All these alcohols contain naturally methyl alcohol. MLLE. PAULE LELU: The comparative digestive utilisation of albuminoid matter in various animal species. The pig has a higher coefficient of digestion than other animal species. B. S. LEVIN and C. PIFFAULT: The increase of the radioresistance of the Protozoa by lecithin in colloidal solution. CL. GAUTIER and R. RICARD: The spectrographic study of ox bile. Manganese appears to be one of the elements eliminated by the bile. ALBERT LAMBRECHTS: Appreciation of the quantity of phlorhizin in the liver and kidneys after intravenous injection in the dog. It is possible by the method of ultra-violet spectrography to detect and estimate phlorhizin in the liver and kidneys. RAPPIN: The microbial etiology of cancer.

CRACOW

Polish Academy of Science and Letters, March 5. M. MIESOWICZ: The refractive indices of some liquids in the domain of the short electric waves. The wavelengths employed were 7·1 cm. and 6·2 cm., an interference method being used. In all the liquids examined except water, the same value was obtained as with very long waves: water, with the shortest wave, gave a slightly higher value. S. DOBINSKI: The viscosity of liquid phosphorus. The results of the measurements suggest that the molecules of phosphorus are associated below 49° C. K. DZIEWONSKI, J. MOSZEW, J. MAKSYMOWICZ and P. TRZESINSKI: A new method of synthesis of compounds derived from quinoline (5). An account of derivatives of 2-phenyl-4-aminophenylquinoline. K. DZIEWONSKI, L. KWIECINSKI, L. STERNBACH and ST. KAMMER: Studies on 1-phenyl-2-aminonaphthylketone. MLLE. O. MYRC: The high peat bog of Strutyn in the neighbourhood of Dolina. The results of a pollen analysis of the peat, with deductions. M. JANICKI: Contribution to the biology of *Dioctophyme renale*. J. ZACWILICHOWSKI: Researches on the innervation of the sensorial organs of the wings of *Phyllodromia germanica*. TH. VETULANI and ROB. SCHULTZE: The hypothesis of the small Polish horse representing the steppe 'tarpan' type, especially that of the sylvan 'tarpan' (3). J. KRUSZYNSKI: Cytochemical experiments on the incinerated nerve cell. Results obtained from the study of incinerated sections (spodogram) of nerve.

LENINGRAD

Academy of Sciences (*C.R.*, No. 8). S. SOBOLEV: A new method for the solution of Cauchy's problem. G. SOKOLOV: A property of trigonometric sums. V. FOCK: A certain definite integral connected with the cylindrical function $K_v(X)$. D. EROPKIN and V. KONDRATJEV: The atmospheric bands of $O^{16}O^{18}$ in the solar spectrum. S. SHUBIN and S. VONSOVSKIJ: Contribution to the theory of exchange interaction. I. TAMM and S. ALTSCHULER: The magnetic momentum of neutrons. S. FRISCH and V. MATVEJEV: Properties of atomic nuclei of certain elements. J. M. TOLMACHEV: Qualitative and quantitative determination of lithium, rubidium and cæsium by spectroscopic methods. V. TCHULANOVSKIJ and M. MOCHNATKIN: Fine structure of the line He II, 1640 A. V. TCHULANOVSKIJ: The rotation structure of the band of the nitrogen molecule in the Schumann region. G. KRUTKOV: Linear problems of the theory of Brown's motion (1). I. KURCHATOV, G. SCHEPKIN, A. VIBE and V. BERNASHEVSKIJ: γ-Rays in the bombardment of boron with protons. A. BRODSKIJ and F. TRACHTENBERG: The application of the theory of Debye and Hückel to non-aqueous solutions. M. NEMTSOV and G. SIPOVSKIJ: Investigation of catalysts for destructive hydrogenisation (1). Hydrogenisation of naphthalene in the presence of molybdenum sulphide. V. SADIKOV, V. A. VADOVA and R. KRISTALLINSKAJA: Fractionation of protein catalysts with the help of organic extract substances (2). R. BELKIN: Studies in regeneration in Amphibia (1). Regeneration of legs on the back. B. ISATCHENKO, M. ONTCHUKOVA, A. PREDTETCHENSKAJA and T. LIPSKAJA: Spontaneous heating of grain. One of the main factors is the humidity of the grain. E. ASRATJAN: Systematisation in the work of the great hemispheres of the brain. O. WALTHER and M. LILIENSTERN: Contribution to the diagnosis of sex in hemp. The growth cones of hemp are biochemically differentiated in respect of sex and may be used for the diagnosis of sex in the early stage of the development of hemp. G. VERESCHAGIN: Thermal properties of running water.

VIENNA

Academy of Sciences, April 26. JOSEF HOFFMANN: Radiation changes in the lead oxide series and also of various mixtures of metallic oxides or salts with arsenic. ANTON KAILAN: Chemical actions of penetrating radium radiation. (20). Action on aqueous solutions of glycerol, isobutyl and ethyl alcohols, and benzene. For the three alcohols named, the value of *m*—the number of equivalents of mono- or dibasic acid formed per second of irradiation period in excess of that given by the non-irradiated liquid—is of the same order of magnitude as *n*, the number of ion-pairs which would be produced in the vapour of the liquid by the part of the β- and γ-radiation absorbed by the liquid. The same holds for the aldehyde formed. With benzene, however, *m* appears to be 0·1–0·01 times *n*. FRITZ ASINGER: Migration of bromine during the side-chain chlorination of bromotoluenes. No loss of bromine occurs during this migration, and it is assumed that the reaction depends on the formation of chlorine bromide. ANTON WACEK and HEINRICH LÖFFLER: The detection of certain volatile amines with the view of the investigation of biological processes. Various modifications have been made in Klein's method of detecting these amines. ERNST BEUTEL and ARTUR KUTZELNIGG:

Keratin: (1) the lead sulphide reaction. The action of light on horn and wool apparently converts part of the sulphur of the keratin into the sulphide ion. KARL SCHWARZ: The velocity in heavy water (D_2O) of the ester hydrolysis catalysed by hydrogen ions. As is the case with the inversion of sucrose, the velocity of hydrolysis of methyl or ethyl acetate in heavy water at 25° is greater by 50 per cent than in ordinary water. FRITZ KLUTKE: Relaxation vibrations and production of vibration. A new theory of so-called relaxation vibrations, making use of linear differential equations with step-wise alterable coefficients, is described. FRIEDRICH LAUSCHER and FERDINAND STEINHAUSER: Further investigations on the radiation in Vienna and its neighbourhood. JOSEF KEINDL: Geomorphological studies in northern Norway. LEONORE BRECHER: Location of the formation of tyrosinase in caterpillars (*Pieris brassicæ*, L.) prior to pupation. KURT EHRENBERG: Comparative investigations on the skull and teeth of the cave hyena and its living cognates.

May 3. ERNST KATSCHER and HANINA LEHR: Derivatives of symmetrical and asymmetrical *m*-xylenol. The constitutions of various derivatives are indicated. EGON JUSA and GEORG BREUER: Influence of the position of the mercapto or methylmercapto group on the colour of the monosubstituted α-naphtholazo dyes. In the 7-position the mercapto group has a hypsochromic, and in the 6- or 8-position a bathochromic effect. In all three cases methylation of the mercapto residue displaces the colour towards the blue. EGON JUSA and LEO GRÜN: Influence of position isomerism and methylation at the sulphur on the colour of mercapto-α-naphtholazo dyes. ANTON KAILAN and VALERIE KIRCHNER: Measurements of esterification velocities and viscosities in ethyl alcoholic hydrochloric acid, with and without added neutral salts or benzophenone. ANTON KAILAN and LEO JUNGERMANN: Esterification velocities of substituted fatty acids. The retarding effect of various substituents on the esterification velocity of acetic acid increases in the order, Cl, Br, C_6H_5O, I, CN. When a bromine atom replaces a hydrogen at an α-carbon atom, the retarding effect increases with the length of the carbon chain. FRANZ PATAT and HANS HOCH: Contribution to the determination of spin and statistics of the deuton nucleus from thermal data. The use for this purpose of two methods, namely, determination of (1) the constants of the equilibrium $H_2 + D_2 \rightleftarrows 2HD$ at low temperatures, and (2) the conversion of para- into ortho-deuterium, is discussed. KARL MAYR: Iteration of linear functional operations. FRITZ SÖCHTING: An approximation solution of Varignon's problem. FRITZ LIEBEN, LUISE LÖWE and BELLA BAUMINGER: Decomposition of highly polymeric carbohydrates, lactic and pyrotartaric acids in the light of the quartz lamp. MAX BEIER: Preliminary report of a zoological excursion to western Greece.

Forthcoming Events

INTERNATIONAL CONGRESS OF ANTHROPOLOGICAL AND ETHNOLOGICAL SCIENCES, July 30–August 4. To be held at University College, London, W.C.1.

TWENTIETH INTERNATIONAL CONGRESS ON ALCOHOLISM, July 30–August 30. To be held at the Imperial Institute, South Kensington, London, S.W.7.

Official Publications Received

GREAT BRITAIN AND IRELAND

Micro-Chemical Methods suitable for General Analytical Practice. By Dr. H. V. A. Briscoe and Dr. Janet W. Matthews. (Two Lecture-Demonstrations.) Pp. 42. (London: Institute of Chemistry.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1574 (I.C.E. 959): Effect of Fuel Evaporation on Performance of a Centrifugal Supercharger. By G. V. Brooke. Pp. 15+7 plates. 1*s*. net. No. 1580 (T. 3387): Frictional Drag of Flat Plates below the Critical Reynolds Number. By A. Fage. Pp. 7+2 plates. 6*d*. net. (London: H.M. Stationery Office.)

Report of the Department of Agriculture of the University of Leeds and of the Yorkshire Council for Agricultural Education for the period 1st October 1932 to 31st March 1934. Pp. 20. (Leeds.)

Leeds University: Department of Pathology and Bacteriology. Annual Report by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research by Prof. R. D. Passey, 1933. Pp. 15. (Leeds.)

Board of Education: Welsh Department. Education in Wales: Report of the Board of Education under the Welsh Intermediate Education Act, 1889, for the Year 1933. (Cmd. 4610.) Pp. 20. (London: H.M. Stationery Office.) 4*d*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 6: A Convenient Method of Measuring Resistances of the order of 10^{12} Ohms with a Sensitive Ballistic Galvanometer. By Dr. J. H. J. Poole. Pp. 57–58. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

OTHER COUNTRIES

Cornell University Agricultural Experiment Station. Bulletin 580: Pruning and Training Tomatoes. By H. C. Thompson. Pp. 14. Bulletin 581: Factors Influencing the Occurrence of Potato Scab in New York. By F. M. Blodgett and F. B. Howe. Pp. 12. Bulletin 582: Relation of Cities and Larger Villages to Changes in Rural Trade and Social Areas in Wayne County, New York. By Harold C. Hoffsommer. Pp. 61. Bulletin 583: The Relationship of the Open-Country Population of Genesee County, New York, to Villages and Cities. By Edward A. Taylor. Pp. 59. Bulletin 584: Relationships of Open-Country Families of Onondaga County, New York, to Socio-Economic Areas, Villages and Cities. By Alfred Moore Paxson. Pp. 71. Bulletin 585: An Economic Study of the Marketing of certain Perishable Farm Products in Albany, New York. By Wilbert C. Hopper. Pp. 61. Bulletin 589: A Study of the Effect of removing Foremilk on the Fat Content of the Remainder of the Milking. By H. E. Ross and Helmuth Winther. Pp. 7. Bulletin 594: Production of Early Blooms of Chrysanthemums by the use of Black Cloth to reduce the Length of Day. By Kenneth Post. Pp. 30. Memoir 151: Manganese an Essential Element for Green Plants. By Edwin Fraser Hopkins. Pp. 40+5 plates. Memoir 152: The Relative Growth and Development of Corn Varieties of widely Different Maturity Dates during Successive Time Intervals throughout their Life Cycle. By R. G. Wiggans. Pp. 36. Memoir 162: Longevity of *Rhizobium japonicum* in relation to its Symbiont on the Soil. By J. K. Wilson. Pp. 11. (Ithaca, N.Y.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 35, Part 2: On the Ethereal Sulphate, the Essential Constituent of Agar-Agar. By E. Takahashi and K. Shirajama. Pp. 101–132. Vol. 35, Part 3: Supplementary Notes on the *Platypodidæ* of Formosa, IV. By Jozo Murayama. Pp. 133–150. (Tokyo: Maruzen Co., Ltd.)

Spisy vydávané Přírodovědeckou Fakultou Masarykovy University. Čis. 185: Doba polovičních srážek a periodická amplituda ročního srážkového průběhu v Československu (Temps des demi-précipitations et l'amplitude moyenne de la période des précipitations atmosphériques annueles en Tchécoslovaquie). Napsal Bohuslav Hrudička. Pp. 22. Čis. 186: Aromatické sulfonany prvků druhé skupiny periodické soustavy (Salts of Aromatic Sulphonic Acids with the Elements of the Second Group of the Periodic System.) Napsali V. Čupr a J. Širůček. Pp. 23. Čis. 187: O stočených skupinách krystalů křemmených ze Švýcar (Sur les groupements tordus des cristaux du quartz de Suisse). Napsal Dr. V. Rosický. Pp. 31. Čis 188: Užití teorie homologie na teorii souvislosti, I (Applications de la théorie de l'homologie à la théorie de la connexite, I). Napsal Eduard Čech. Pp. 40. Čis 189: Příspěvek k studiu kladélkové pochvy bylinných vos rodu *Arge* Schrk. a *Schizocera* Lep. and Serv. (Beitrag zur Kenntnis der Sägescheide der Blattwespengattungen *Arge* Schrk. und *Schizocera* Lep. and Serv.) Napsal Emil Hachler. Pp. 11. Čis. 190: Detektory mechanických kmitů (Über die detektoren mechanischer Schwingungen). Napsal Josef Zahradníček. Pp. 26. (Brno: A. Píša.)

Spisy Lékařské Fakulty Masarykovy University. Svazek 13, Spis 125–131. Pp. 204. (Brno: A. Píša.) 30 Kč.

CATALOGUES

Cambridge Automatic Regulators. (Folder No. 41.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

First Aid for the Car. Pp. 28. (London: Sternol, Ltd.)

B.D.H. 'Spot' Test Outfit. Pp. 4. (London: The British Drug Houses, Ltd.)

Books, Periodicals and Pamphlets on Entomology. (New Series, No. 35.) Pp. 44. (London: Wheldon and Wesley, Ltd.)

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CONTENTS

The Government and Inland Water Survey

THE short official statement published in NATURE of July 21, p. 93, of the reception by the Minister of Health of the joint deputation from the British Association and the Institution of Civil Engineers, in reference to the memorial previously addressed by those bodies to the Prime Minister on the urgent need for the institution of a National Inland Water Survey, will have been read by those most keenly interested in the subject with a sense of profound disappointment. Despite the assurance of Sir Hilton Young that the suggestions of the memorialists would receive the most careful consideration of the Government, the underlying implication of his remarks that the sources of information at the disposal of the Ministry of Health are considered (with some possible slight amplification in detail) adequate for meeting the requirements of the situation, has created a feeling of serious misgiving. There is a growing conviction that the matter is being side-tracked for departmental reasons, and that the real nature of the application and its vital importance are not properly realised.

In the first place, it is difficult to understand why the deputation was referred by the Prime Minister to the Minister of Health. The memorialists had clearly indicated and given reasons why the matter should be dealt with by the Department of Scientific and Industrial Research. Apart from other considerations, the scope and aim of the survey contemplated is far wider and more comprehensive than the interests of the Ministry of Health. It is true that the Ministry is intimately concerned with, and exercises supervision over, questions of public water supply, and that the legislative proposals of water undertakers are referred to that department for investigation and approval. But a water survey, if it is to be of national utility and value, must transcend the relatively narrow limits of public health and take account not merely of supplies of water for domestic consumption but also the no less important needs of industry and commerce, the possible creation of hydro-electric motive power, the requirements of fisheries, irrigation and navigation, the drainage of low-lying lands and the prevention of floods and safeguarding of lives and property, with a score of other matters which do not come, or only come very indirectly and remotely, within the purview of the Ministry of Health.

This department of public health, moreover,

despite the assurance which we have stated is implied, if not definitely expressed, in Sir Hilton's speech that it is capable of dealing with all the requirements of the case, will, as he himself admits, be dependent for the major part of such information it may require on various external organisations, such as the Catchment Boards and the Geological Survey. The Catchment Boards, created under the Land Drainage Act of 1930, are undoubtedly in a position to render very effective and valuable service in the gauging of rivers and streams (this was pointed out in a leading article in NATURE of November 5, 1932) as it is indeed one of their primary duties and responsibilities, but they report to the Ministry of Agriculture and Fisheries and not to the Ministry of Health. Similarly, the Geological Survey comes under the Department of Scientific and Industrial Research, and is in no sense a branch of the Ministry of Health. The Ministry of Health cannot supervise and control the operations of these bodies, or lay down rules for their guidance.

The fact is that in Government circles there is some confusion of thought on the matter. Replying to a question in the House of Commons, on July 16, asking whether a survey of the water supplies of the country would be instituted, Sir Hilton Young made the statement that: "A survey of water supplies is undertaken by the Ministry as part of their ordinary work, and a special organisation is not necessary." We have no wish to be discourteous, and we are not charging Sir Hilton with intentional misrepresentation, but we are obliged to point out that in the strict technical sense of the word, the statement is not true. There is no survey of the kind contemplated in the question, nor in the sense in which it is used by the deputation, in operation at the present time. This is the whole point of the report of the investigational Committee of the British Association. Sir Hilton Young probably had in mind certain returns and records supplied to the Ministry of Health by various water companies, and others, but these are necessarily fragmentary and incomplete, relate to established undertakings, and do not in any way meet the considered finding of the British Association Committee "that a systematic survey of the water resources of Great Britain is urgently required".

It is essential to proper appreciation of the situation that the sense in which the word 'survey' is used, both by the British Association and the Institution of Civil Engineers, should be clearly understood. Here are the *ipsissima verba* contained in the British Association Committee's report:

"The scope of a water survey to meet the requirements of civil engineers and others interested in water conservancy should include observations and measurements and the preparation of continuous records in standard form, in connection with rainfall, surface storage and flow, and underground storage and flow—in conjunction, in each case, with the physical and geological characteristics of the area. The records from all sources should be collated, brought into harmony and made available."

The report goes on to show, as a result of the Committee's widespread inquiries, that, while "some bodies take gaugings and measurements and keep records for their own purposes, so far as it has been possible to ascertain, these form a small minority and, in general, there is an entire absence of co-ordination or of any organisation for systematic recording of data". Hence the need, and it has become a clamant need, for a properly organised national survey "of all water received in these islands from its first arrival in the shape of rain and dew to its final disappearance in the ocean".

The Department of Scientific and Industrial Research is, as was stated in the memorial to the Prime Minister, particularly suitable for instituting and supervising a scientific investigation of this kind. It would be able to advise on methods and operations, on instruments and appliances, in a way that no merely administrative bureau could be expected to do. Assistance in the taking of observations and measurements will have to be enlisted from various quarters, private as well as public, and it was pointed out in the article in NATURE to which we have already alluded, that there must be some centralised authority of high technical standing to supervise and unify the methods and systems of measurement, otherwise the records will tend to be of different values. The Department of Scientific and Industrial Research, comprising as it does such related branches of work as the Geological Survey and Water Pollution Research, is specially adapted for the purpose, and, moreover, it has the outstanding merit of being entirely independent of interest of any sort in the use and control of water. This is a most important consideration and is a qualification for the body to be entrusted with the survey

specially emphasised in the report of the British Association Committee.

From the half-forgotten lore of one's school-days one recalls an incident in the Fables attributed to Æsop which may give point to these observations. It is the story of the ox, who, desiring to feed at its stall, found a dog in possession. Despite all reasonable argument to induce it to go, the dog obstinately refused to give way. We should hesitate to affirm that the Ministry of Health is deliberately pursuing the policy of the "Dog-in-the-Manger", but there is a danger that its action may be so construed, and it is to be hoped that wiser counsels will prevail. With its onerous duties and responsibilities in many directions, the Ministry will find it advantageous to waive any particular concern it may have in the present question in deference to the wider interests involved, and, at the same time, it will be able, from the undoubted store of records and returns which it possesses relating to existing undertakings, to render invaluable aid to the Department of Scientific and Industrial Research in an investigation which will call for the earnest and painstaking co-operation of everybody concerned.

The matter is too vitally important to the nation at large to be shelved or ignored. Great Britain lags behind the practice of other countries, which have long since recognised the necessity of investigating and conserving their water resources. The Dominion of Canada, the United States, Germany, Italy, Switzerland and many other nationalities have inaugurated special departments to deal with the control and administration of water within their respective territories. Unless the British Government is prepared to follow their example it will fail to provide for the developments which are impending in civic and industrial life and the nation will continue to find itself involved in unpleasant predicaments, which must accompany a short-sighted policy.

The question of the systematic allocation and distribution of the water resources of Great Britain raises, however, a number of subordinate issues for the discussion of which the present occasion is not opportune. The matter of supreme importance at the moment is the establishment, on lines of scientific accuracy, of a complete survey of the national water resources. This, it is urged, is not a duty germane to the functions of the Ministry of Health: it can only be undertaken effectively through such a body as the Department of Scientific and Industrial Research.

The Passing of Rural Crafts

(1) *Change in the Farm.* By T. Hennell. Pp. x+201. (Cambridge: At the University Press, 1934.) 10*s.* 6*d.* net.

(2) *The Wheelwright's Shop.* By George Sturt ('George Bourne'). Reprint. Pp. xii+236+8 plates. (Cambridge: At the University Press, 1934.) 7*s.* 6*d.* net.

MANY of us who are immediately associated with scientific work are in certain respects very fortunate. Our horizon is continually expanding and we can look back to the past with a feeling of confidence that the work put in hand by our forefathers has been carried steadily forward in the way they would have wished. This state of happy confidence is sadly lacking in many directions, conspicuously so in the field of economics and international politics. But we can find the same feeling of uncertainty much closer at hand in our own countryside. Are the changes which have come about in our rural economy during the last half century changes for the better?

(1) It was in the hope of getting some new light on this problem that we eagerly scanned Mr. Hennell's book. Certainly there is here much information which it is satisfactory to have collected together between two covers. The book is a compilation of notes on sundry matters rather than a narrative, and for this reason does not leave any very clear impression on the mind except perhaps that the writer resents the passing away of the practices he describes. His readiness to quote the opinion of farmers who see objections to new departures, such as the use of 'artificials' and the cultivation of sugar beet, further reveals his prejudices. The principal praise he can find for the county organisers is that they have been the means of introducing into the eastern counties of England the more thorough methods of hedging which have been developed traditionally in the Midlands. It would, perhaps, have been better to omit altogether a reference to these admirable men than thus to praise their work so faintly.

In any event, Mr. Hennell does not take us to the root of the matter. The changes in the farm that really matter are not the alterations in a hundred and one details, but the gradual changes which have taken place in the relationships of the farm labourer to his work and to his employer. On the material side, he has reason to thank the effects which the industrialism of the towns has

had upon his life. His wages are higher and his hours shorter, and there is much more that he can do with his spare money and spare time. Intellectually also he is able to scan, at least in part, the widened horizon of the modern townsman.

(2) The price he has had to pay, however, is readily appreciated on reading "The Wheelwright's Shop", a photographic reprint of which has recently appeared. George Sturt does not set out in this book to be a social philosopher. At the same time it is quite clear that he is keenly aware of the human side of recent changes in rural life. Nine-tenths of the book are devoted to a graphic description of the wheelwright's trade as he had experienced it, and fascinating is his telling of it. It is the personal side, however, which makes the work such a satisfactory whole, and it is this side also that leaves the most lasting impression. One cannot but be moved by his description of the men with whom he worked. It may be that he idealises them, but there can be little doubt that modern conditions are not so favourable to the emergence of the fine qualities he so greatly appreciated. We are also guided towards an understanding of why the change has occurred.

Under the conditions which prevailed when Sturt took over the management of his father's wheelwright shop in 1884, no power was available beyond that which human muscle could provide. In such circumstances success depended more on skill than brawn, and skill is only won by early apprenticeship and long experience. Years of application to their trade made his men masters of the crafts that had been handed down to them in the minutest detail by an older generation. Although as regards the method of receiving their weekly pay they were employees, yet they held an unassailable place in the village community. They knew how the work should be done, not from an employer's instruction, but because they had through long-sustained effort become the inheritors of an ancient lore.

Economic pressure led Sturt in due course to introduce power-driven machinery, but he recognised this as something which cut at the roots of the old system. When a lad tending a machine can do work that could formerly only be done through the skill of a craftsman, how is one to retain that respect for the old wisdom which was formerly the basis of country life? Yet how are traditional methods to survive in a world that regards them as too expensive? The old craftsmen were not of course uninfluenced by economic forces, but it was undoubtedly the aim of the best of them to do their work as well as they could afford to do. While this spirit is by no means dead, it must be admitted that the man who can do the job most cheaply is nowadays counted the most successful. We have grown so accustomed to a world of profit-making, in which success and social position are so largely conditioned by money, that it is salutary to be reminded that this is after all a very modern innovation, and may neither be a good nor a lasting phase of human evolution. There was, after all, something very satisfactory about a system in which money was of rather secondary importance, and in which a man won the respect of his neighbour by the excellence of his craftsmanship and the soundness of his domestic life.

There is, therefore, ample justification for resentment which Mr. Hennell evidently feels at the passing away of the many country practices which he describes. In a great many cases the newer methods are no better than the old—in some cases they are definitely worse—but they have been adopted of necessity because they are cheaper. The writer of "The Wheelwright's Shop" is also resentful, and pours out his soul in describing the ruthless cutting of woodlands which occurred during the War. He is, however, ready to admit that some of the newer practices are undoubted improvements, such as the substitution of tyres for strakes; and that some of the work that can now be done by power-driven machinery did involve the consumption of an amount of physical exertion that made those parts of the work very irksome.

It is emphasised that there was no 'science' behind the traditional methods of the wheelwright, or of any other rural craftsman for that matter. There was a well-established method of carrying out each of the operations, and it did not occur to anyone to reason out why it was best to do it in that particular way. The 'dish' of a cart-wheel is a case in point. Everyone knew that the spokes must not lie in a plane but must describe an obtuse cone. Cases could be cited where wheels with insufficient 'dish' had collapsed. But no one could explain just why this was; it was accepted as a fact. The dished cart-wheel embodies a very ingenious solution of a complex problem. The more straightforward solution of straddling the spokes on the hub (or stock), which is quite usual now, was not practicable under road conditions in which ruts were sometimes two feet

deep. It was necessary that the spokes should not touch the sides of the rut cut by the rim, and this meant that they must all come from the same circle on the stock. The stability of the wheel had therefore to be secured in a more subtle way, and it is possible that even George Sturt has not completely laid bare the 'science' of the cart-wheel. R. KENWORTHY SCHOFIELD.

Evolutionary Tendencies

Early Forerunners of Man: a Morphological Study of the Evolutionary Origin of the Primates. By Prof. W. E. Le Gros Clark. Pp. xvi+296. (London: Baillière, Tindall and Cox, 1934.) 15*s*.

NON-COMMITTAL though it may be, the very title of Prof. Le Gros Clark's book excites curiosity. Forerunners are not necessarily ancestors; and in fact these pages introduce animals which stand in varying relation to the true line of human descent. It must not be supposed that the author avoids discussion of that subject. The preface is perfectly explicit in this matter, and ancestral trees, though not unduly prominent, figure clearly enough towards the end of the volume. But a wider issue is submitted, namely that of the evolutionary history, not of man alone, but of his associates as well. The clear statement of this aim, and the steadfastness which ensures its maintenance throughout the inquiry, are the essential factors of the book's outstanding merit.

It is a pleasant and easy part of the present survey to refer to the author's special qualifications for so ambitious a task, to recognise the ability with which he has marshalled the relevant evidence and to commend the delicacy of touch which has provided numerous illustrations combining anatomical accuracy with tasteful execution. As his record proclaims, Prof. Le Gros Clark is highly qualified by reason of his very thorough knowledge of human anatomy. He has also enjoyed the advantages of field-work in tropical surroundings, favourable to the existence of many of the animals he describes, and even more distinguished as part of that circumscribed area which provides the only refuge for one particular example. Since his return from the tropics, Prof. Le Gros Clark has worked assiduously for ten years on the anatomy of the various forms collected by him. Nor has he neglected the palæontological aspects of his problems, for as his published work shows, he has supplemented a general survey by a special investigation of the important fossil *Pronycticebus*.

In arranging the evidence he has summarised his own extensive researches, and has amplified these by the inclusion of recent contributions made by several contemporary workers. Among the latter, the names of Sir G. Elliot Smith, Prof. Wood Jones, Prof. H. H. Woollard, and Dr. Beattie are prominent in regard to the study of existing forms, while those of Prof. W. K. Gregory and Prof. O. Abel, Mr. Simpson and the Abbé Teilhard de Chardin appear in respect of palæontological studies.

The evidence is drawn from the animals commonly acknowledged as associates of mankind, whatever opinions may be held in regard to their exact relations to man or even to one another. Thus it is that the lemurs and monkeys have figured in classifications since the Linnean scheme appeared in the eighteenth century. The earlier specifications included bats. But whereas these are now excluded, two important additions demand special mention, namely, the aberrant lemurine form *Cheiromys*, and the remarkable *Tarsius*, both unknown in the time of Linnæus. Sundry examples, represented only by fossil remains, are included, and the whole group thus constituted forms the order Primates. The approximation of the order Insectivora to the Primates has been recognised in so far as the animals are concerned though not as regards their comprehensive name, since the publication of John Ray's "Classification" (some two hundred years ago). Originally, the approximation was based on the claims of a few anatomical data. Not only have embryological data supplemented them, but also the anatomical evidence has been vastly increased by the work of Prof. Le Gros Clark himself and those whose names are given above, particularly Sir G. Elliot Smith. One noteworthy result has been the proposal to detach certain animals formerly included with the Insectivora, so as to transfer them to the order Primates. On the side of palæontology too, the researches of Mr. Simpson have revealed the existence of an insectivorous form possessing distinct resemblances to the lemurs. Again, and within the Primates, M. Teilhard de Chardin has discovered European tarsioids differing from the previously known American examples, in that the European forms exhibit features suggestive of an approach to the subdivision of the Primates called Anthropoidea.

Prof. Le Gros Clark has had to condense and summarise all these researches, and he has done so with a success which carries his book far ahead

of anything previously published in this particular sphere. If the book be regarded as the exposition of a particular thesis, it is fair to state that it culminates in twofold fashion, namely, the exhibition of certain "*ancestral trees*" and in the second place, the tables of *specifications*.

In regard to the ancestral trees, comparisons are inevitable, and in the present instance it is impossible to ignore the remarkable degree of correspondence between the diagram given as Fig. 89, p. 275, with part of that published in Sir G. Elliot Smith's book, entitled "Essays on the Evolution of Man", 1927, Fig. 2, p. 3. The chief differences seem to consist first in the nomenclature. Thus Prof. Le Gros Clark sets Prototarsioids in the place filled by Tarsioids in the older scheme, and again he sets Tarsioids where the older scheme has *Tarsius*. Secondly, the older scheme doubtless includes *Parapithecus*, but does not mention this fossil by name. Unless these divergences are more important fundamentally than they appear to be, Prof. Le Gros Clark confirms what may be termed the prevalent view of the relations of the various forms represented in the two schemes. Particular agreement appears in that the human stock is connected with those representing monkeys in a position to be described as more recent than the tarsioid or prototarsioid stage. Whether this provides material for discussion or not, it must suffice here to refer once more to the greatly enlarged store of information which lies at the base of the more recent exposition.

Inspection of the specifications discloses at once that the method employed is systematic in the strictly anatomical sense, inasmuch as the distinctive traits are drawn successively from the bones, the teeth, the nervous system or the uro-genital system. But it would be an error to pass them over as mere lists. Their essence and value consist in the attempt here made to define a given group of animals in terms not simply of anatomical conformation, but rather of certain trends or tendencies in evolution manifested by the assemblage considered as a whole. Such an attempt certainly confers distinction upon the book, and may well mark the inauguration of a new method of classification more profitable than those in vogue. Some implications of this method are mentioned by the author in his introduction, and it would seem that occasionally the tendencies in question may find expression as instances of parallel development, of which some examples are cited. Moreover, the comparison of such trends seems to lead to the conception that some of them are predetermined, so that evolutionary progress may follow certain lines to the exclusion of all others. Consequently the influence of a variable environment in promoting evolutionary changes must be correspondingly discounted in those instances.

The introduction of such considerations is a novel and welcome supplement to the descriptive part, and though they may incur criticism of an adverse kind, they will assuredly assist in the solution of difficult problems, provided the distinction between facts and theories be kept in mind. Here the contrast must be drawn between a concept (orthogenesis) based upon a conclusion, and the facts. And the latter emerge from the specifications in their natural form, namely, as anatomical details. This brings out another fundamental principle enunciated by Prof. Le Gros Clark (p. 4), when he records his conviction that degrees of genetic affinity are assessed by noting degrees of resemblance in anatomical details. Such support to the value of anatomical records is the more welcome in an epoch marked by the inception of physiological and psychological alternatives. Lastly, another pronouncement will almost certainly command attention, namely, that in assessing affinities, all anatomical characters must be taken into account (p. 8).

In conclusion, it may be remarked that these pages leave several subjects (such as the real nature and significance of *Parapithecus*) open to discussion and invested with doubt. But there is no doubt as to the general excellence of Prof. Le Gros Clark's book.

Progressive Biochemistry

(1) *Organic and Bio-chemistry*. By Prof. R. H. A. Plimmer. Fifth edition. Pp. x+624. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 21*s*. net.

(2) *Fundamentals of Biochemistry: in relation to Human Physiology*. By T. R. Parsons. Fourth edition. Pp. xii+435. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1933.) 10*s*. 6*d*. net.

(1) PROF. PLIMMER'S book has for many years been regarded as a classic. The first edition was published under the title of "Practical Physiological Chemistry" in September 1910, and fresh editions were called for in 1915,

1918 and 1926, the third edition having also a second impression in 1920.

The seven years that have elapsed since the last edition of the book have been far from barren ones in biochemistry, and comparison with the fourth edition would undoubtedly reveal that most of the important additions to knowledge in this science have been brought into their appropriate places by the author. The scope of the book is difficult to indicate in a few paragraphs, but it may be mentioned that some thirty-five chapters are devoted to discussion of different classes of organic compounds, while separate chapters discuss the fats, oils, waxes and lipines, with a special chapter on the estimation of carbohydrates. There are also special chapters on the alkaloids, pigments, the proteins, protein derivatives, colloids, milk, fermentation, digestion, metabolism, the composition of foodstuffs, respiratory exchange, urine and fæces. The three chapters on the special chemistry of proteins are particularly interesting, in view of the author's position as an original investigator in this field. The introductory paragraph and note on the "Recognition of an Organic Compound" precede chapters on the "Isolation and Preparation of Pure Organic Compounds", and on the "Composition of Organic Compounds", with a note on identification.

It is clearly impossible in any real sense to review a book of this sort; all the reviewer can do is to dip here and there in a search for inaccuracies, if he is that type of reviewer, or in the conviction of finding useful and clearly expounded knowledge, if his temperament is of another kind. It can at once be said of the reviewers of this book that the former kind would be disappointed, and the latter kind well content.

It is a pity that the publishers have not given practical expression to their realisation—and they surely must realise—that Prof. Plimmer is one of the leading world figures in biochemistry, for the typography of this volume leaves very much to be desired. In particular the printing of the benzene nucleus in its various manifestations and compounds is often slovenly in the extreme. Opening the book more or less at random, one finds unpleasant examples of this fault on pp. 204, 255 and many others.

In spite of these blemishes, which we urge the publishers to remedy in subsequent editions, a whole-hearted welcome can be given to this, as to each previous, new edition of "Plimmer".

(2) Dr. Parsons's little book is another reprinted work of a rather different kind. Only eleven years have elapsed since it was first published, and it is still without exception the best elementary exposition of its subject that I know. It must not, however, be imagined that it is a 'popular' book in the ordinary sense, as it certainly demands a knowledge of elementary chemistry, being intended primarily to teach the young medical idea to shoot in the biochemical field; its effect should definitely be to enable those readers to score the necessary number of marks.

Unlike the first book noticed in this review, it is produced in a manner both creditable to the publisher and worthy of the author. This is not a matter to be regarded lightly in textbooks or introductions to scientific subjects, for chemical formulæ are notoriously repellent, and the least that can be done to encourage their understanding is to present them clearly.

Dr. Parsons's book is not entirely devoid of minor errors; for example, the statement that in piperazine a nitrogen atom replaces a carbon atom in piperidine (it actually replaces a –CH group), and the transposed formula for the biuret reaction giving protein-group on p. 24.

I must also again direct Dr. Parsons's attention to a statement that I criticised in reviewing an earlier edition of his book, namely, that the rats in Hopkins's classical experiments were suffering from vitamin A deficiency. This is entirely inconsistent with the fact, made perfectly clear in Hopkins's paper, that they could be cured by water-soluble extracts from yeast and other substances. In general, however, his statement of the position in the vitamin field is admirable, and he has avoided most of the pitfalls that lie in wait for the unwary simplifier.

The extraordinarily rapid pace of vitamin research is well illustrated by the fact that, although this book appeared in time to chronicle the identification of vitamin C with ascorbic acid, it was too early to record the synthesis, details of which have now been available for several months, of ascorbic acid from entirely inactive substances. Such omissions are the inevitable handicap of those who write about active and growing sciences. One of the tests of the value of such chronicles is whether they encourage the reader to keep eyes and ears open for still later developments, and to understand them when he hears them. Judged by such a criterion, Dr. Parsons's book should be an unqualified success.

A. L. Bacharach.

Short Reviews

The Butterflies of the Malay Peninsula: including Aids to Identification, Notes on their Physiology and Bionomics, and Instructions for the Collection and Preservation of Specimens under Tropical Conditions. By Dr. A. Steven Corbet and H. M. Pendlebury. Pp. v+252+vi–xxiv+18 plates. (Kuala Lumpur: Kyle, Palmer and Co., Ltd., 1934.) 4.50 dollars.

THIS handbook, though primarily designed for the Malayan collector, contains biological and bionomic matter which should be of service to students of the Lepidoptera of other regions. In the portions of the work that are concerned with the collecting, preparation and preserving of specimens, the tropical conditions prevailing in the Malay Peninsula are fully recognised, and the directions given bear the stamp of practical experience.

The authors do not attempt to describe or illustrate more than a selection of the commoner Malay species; they give, however, a complete list of all the species at present recorded from the Peninsula. In the remainder of the book space has been found for matters of wider interest, such as the external anatomy and classification of butterflies, their life-history and geographical distribution. A chapter is devoted to protective resemblance and mimicry; and a brief, but within its limits adequate, account is furnished of the phenomena of Mendelism. This chapter, if read with attention, will provide the field naturalist with ample suggestions for advancing knowledge materially by experimental breeding.

The book will encourage collectors to use their opportunities to scientific purpose. The photographic plates are a good help to the identification of species.

Grondbeginselen van de Hedendaagse Natuurkunde. Door Dr. J. A. Prins. Pp. 240. (Groningen, Den Haag, Batavia: J. B. Wolters, 1934.) 4.90 guilders.

IF teachers of elementary physics are to keep up to date and to render their courses of instruction attractive, it is essential that they should be able to obtain accurate information of recent advances and their incidence on old knowledge, in a readable form. This little book appears to provide such information. It deals with the fundamental concepts of physics in a way which undoubtedly has great pedagogic value. The subject matter is attractively arranged, nicely set forth, very well illustrated, and the book provides a singularly neat introduction to present-day physics, in which practically all the important results of modern research have been incorporated.

If it can be translated into English and put on the market at a reasonable price, it should find a warm welcome. In this case it is to be hoped that the excellent tables now inserted in the cover band will also be included.

Conjugate Functions for Engineers: a Simple Exposition of the Schwarz-Christoffel Transformation applied to the Solution of Problems involving Two-Dimensional Fields of Force and Flux. By Prof. Miles Walker. Pp. v+116. (London: Oxford University Press, 1933.) 12*s.* 6*d.* net.

BY means of a transformation due to Schwarz and Christoffel, the interior of a polygon can be mapped on an infinite half-plane. Problems of two-dimensional flow (of liquids or electric currents) can thus be transformed into problems more amenable to treatment. The present book gives a quite elementary discussion of this transformation and an ingenious method of visualising the process. A variety of illustrative problems are then worked in great detail so that the engineer can at once appreciate the practical application of this powerful method. The book can be heartily recommended to those who have to deal with such problems in engineering practice.

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Vol. 14. W. W. Hartman, Editor-in-Chief. Pp. vii+100. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 10*s.* 6*d.* net.

AMONG the twenty-six preparations given are decamethylene glycol (from ethyl sebacate), β-diethylaminoethyl alcohol (from diethylamine and ethylene chlorohydrin), 2 : 6-dimethylpyridine (from acetoacetic ester, ammonia and formaldehyde), glycine ester hydrochloride (from methyleneaminoacetonitrile, made in turn from formaldehyde, sodium cyanide and ammonium chloride), and *dl*-methionine (from β-chloroethyl methyl sulphide and sodium phthalimidomalonate). Vol. 14 includes later references to preparations described in earlier volumes, and the index covers the contents of vols. 10–14. J. R.

Our Primitive Contemporaries. By Prof. G. P. Murdock. Pp. xxii+614. (New York: The Macmillan Co., 1934.) 14*s.* net.

As an account of 'primitive' man intended for the general reader and the student, this book is written on a novel plan. Instead of attempting a generalised account, the author has taken eighteen peoples—not all contemporary or primitive in the strict sense—and describes their life as they live it day by day in its framework of material, social and religious organisation. It is scarcely necessary to say that the author does not claim first-hand knowledge. His account of the Haida of north-west America, however, has been checked by his own personal field-work. In other instances his material has been drawn from authoritative descriptions. The bibliography appended to each chapter indicates a critical appreciation by the author of his authorities.

Early Man in the Nile Valley*

It is a commonplace of archæological writing to refer to the part played by the great river systems of Egypt and Mesopotamia in the origin and development of civilisation; yet it is only recently that any systematic attempt has been made to ascertain how far the Nile Valley, which has afforded precise evidence of the development of culture in its relatively early stages, might not also, by an examination of geological conditions and their correlation with archæological data, help to solve some of the problems of man's earliest beginnings.

Preliminary reports of the work of the expedition to the oasis of El-Khargeh conducted by Miss Caton-Thompson and Miss Eleanor Gardiner indicate that by the discovery of stone implements in sealed deposits a substantial advance has been made towards an accurate dating of early stages of man's progress in Egypt; but of this the precise extent will be appreciated only when the final report of the expedition is available. In the meantime, Messrs. Arkell and Sandford in the volume now under notice put forward an instalment of what they hope eventually will be a complete survey of the evidence, here pieced together for the first time, to be found in the Nile Valley from the Second Cataract to the Mediterranean, which bears upon its earliest inhabitants up to known pre-dynastic times.

The work was begun in 1926–27 with a survey of both banks of the Nile from Luxor to Kom Ombo and a study of the First Cataract region at Assuan. The following seasons were devoted to the Faiyum, the Nile Delta and then again to Upper Egypt, when the areas around Luxor and southward from Kom Ombo towards Assuan were again examined. It is the work of the first season and the last, the fourth, which is embodied in this volume, covering the ground from Semnah to Luxor.

The Pleistocene period, which is the authors' main concern, has left its mark indelibly on the landscape of Egypt. As they point out, it was a period of copious rainfall. Forest and grassland covered the landscape, and the wadies were running streams. The signs of rainfall are everywhere apparent in deeply dissected plateaux, cliffs torn by gullies, which are often filled with huge boulders, and in the pot-holed and polished beds of dry waterfalls. A brimming Nile has left its traces in the terrace gravels. These now stand at levels, remarkable for their uniformity throughout their length, of 50 ft., 100 ft. and 150 ft., or more, above the present bed of the river. In some, but not all, of these terraces, implements of palæolithic man are found.

Artefacts first appear in the 100 ft. Pleistocene terrace. Prolonged search in the Pliocene gulf deposits and the Plio-Pleistocene gravels has produced nothing that can be regarded as humanly fashioned; but in the 100-ft. terrace, rolled and unrolled early and late types of Chellean implements appear together. The discovery of Lower Palæolithic implements in the northern Sudan and through Nubia is an addition to our knowledge of the distribution of these types. In the earlier implements there is a marked tendency to make use of pebbles as the raw material, and the implements are mostly triangular in form. A flake industry shows a close resemblance to the English Clactonian. This is especially to be noted in the cores. Except in one locality, Dhimit, where there is an intermediate terrace at 75 ft.; the next stage is at 50 ft. Here implements belonging to a later or Acheulean age occur on a number of sites.

It may not be out of place at this point to direct attention to the principles of selection which the authors have followed in describing and figuring implements of Lower and Middle Palæolithic age in this volume. The specimens have been selected from those found on rich sites rather than from sporadic finds, material from the newly discovered Nubian and Sudanese localities being given the preference; in order to illustrate the skill in their manufacture, implements of chert and ironstone, a particularly intractable material, have been chosen rather than those of flint; and only artefacts which can be illustrated natural size are figured. It is to be noted that the assumption is involved that the specimens with which the authors deal are typical of the industries represented.

In the Middle Palæolithic period, the river entered the Second Cataract apparently for the first time, and two terraces, one at 30 ft. and one at 10 ft., poorly preserved, yield early Mousterian and 'typical' Mousterian of Upper Egypt respectively. Then in later deposits of fine gravels, Mousterian flakes give way to the descendant industry of Lower Sebilian, followed by Middle Sebilian from habitation sites which appear when the deposit of silt had passed its maximum and the falling river-level drained the marshes on the Kom Ombo plain. The Middle Sebilian was followed by a very considerable interval, not necessarily connoting, as Dr. Sandford points out, that the country was uninhabited, before the Upper Sebilian appears on sites of which the lowest, south of Edfu, is 35 ft. above river-level.

For more reasons than one, the Upper Sebilian—an unfortunate term, as Dr. Sandford notes—must be regarded as an industry of no little importance in Egyptian prehistory. At present it is

* Paleolithic Man and the Nile Valley in Nubia and Upper Egypt: a Study of the Region during Pliocene and Pleistocene Times. By K. S. Sandford and W. J. Arkell. (University of Chicago Oriental Institute Publications, Vol. 17: Prehistoric Survey of Egypt and Western Asia, Vol. 2.) Pp. xvii+92+44 plates. (Chicago: University of Chicago Press; London: Cambridge University Press, 1933.) 28s. 6d. net.

known from surface flaking floors only, except at Dibeira West in Nubia, where there are the relics of a riverside industry at the 40-ft. level, which shows little dissimilarity from that newly discovered south of Edfu. It is an industry of little but microliths. Its cores are of two forms: one, a double-ended type, can be traced through Middle and Lower Sebilian; the other, essentially a neanthropic form, is made from a small elongated pebble, from which the two ends have been removed. Geometric forms are common, but the burin and the "Aurignacian retouch" are absent.

It is evident that the series has little in common with Lower and Middle Sebilian; and Dr. Sandford concludes that notwithstanding the view of M. Vignard, who holds that Middle Sebilian forms lead up to Upper Sebilian, a new and outside influence entered the culture of Egypt in Upper Sebilian times. This he associates with Capsian, holding as a necessary corollary that in Egypt Mousterian forms and technique lingered late*.

A point of further interest in connexion with Upper Sebilian and its possible Capsian affinities is suggested by the rock-drawings at Wadi el-Arab and near Abu Simbel which are here described. The oldest of these drawings, depicting giraffes, are compared with the oldest of the series at Uweinat, in the Libyan Desert, in which the Abbé Breuil finds Bushman affinities. This is interesting in view of the fact that our authors would deduce for the earliest of the drawings at Wadi el-Arab a dating which would equate them with the Upper Sebilian.

It remains only to say that an excellent piece of work has been worthily produced by the Oriental Institute, with a selection of well-chosen and admirably reproduced illustrations.

* For the discussion of a similar problem in an analogous context reference should be made to M. R. Vaufrey's communication on the Capsian in Tunisia in *L'Anthropologie*, **43**, 5–6 (see also NATURE, **133**, 107, Jan. 20, 1934).

A New Opportunity for Museums

If Government museums and a relatively small number of municipal and private museums be set on one side, it may be said that the others have struggled along, many fighting but to retain a place, without much encouragement or help from the public, the education authorities, or indeed from any of those who stand to gain most from the use of museum exhibits. Financial encouragement was lacking, so that collections (often free gifts) could not be properly developed or attractively displayed, but even more disabling was the lack of interest, which tended to drive the curator and his staff (if any) back upon themselves, and to repress efforts and schemes which even a modicum of outside interest would have caused to bud and blossom.

Three years ago an opportunity arose for the bettering of museums through the generosity of the Carnegie United Kingdom Trust, which had been led to see the educational possibilities lying hidden to most eyes in the rich stores of galleries and lockers. Grants were offered for the suitable development of collections from an educative point of view, but the grants were limited to municipal museums and to these in the smaller towns, with populations between 10,000 and 70,000, provided they received a due proportion of financial aid from rates and other local sources.

The restrictions proved to be hampering, and now, at the suggestion of the Museums Association, which has been intimately associated with the scheme in planning and in the allocation of grants, the restrictions are to be modified in the direction of allowing more easy access to grants. The original scheme was planned to run a five years' course; three of the years have passed, and the remaining two years will test the new arrangements.

Put generally, the object of the Carnegie United Kingdom Trustees is to encourage curators of museums and governing bodies to improve the museum service in their own and in neighbouring areas, and this object is being furthered in two directions, by grants for development and grants for rural service. The grants are no longer confined to municipal museums, nor are they limited to areas falling within definite population limits. They are intended to encourage the working out of any new scheme which will increase the effectiveness of the museum concerned in relation to the community. There are, of course, certain restrictions. It is only fair that the locality should make its contribution, and so no museum need apply unless it receives from rates, income from endowments, or subscriptions, a sum equal to at least threepence a head of the local population. It must have besides (or be about to have) a competent curator, and if the town in which the museum is situated is a large town, the museum must have, in addition, at least one full-time scientific or technical assistant for every 60,000 of the population.

Development grants, which are not meant to be expended on the ordinary running or maintenance costs, but on new endeavours, will not exceed £250 each, and may be considerably less.

Grants for rural service are new, and ought to spread, more than any other effort, an appreciation of museum collections and museum possibilities. The notion, which was effectively illustrated at a special Exhibition of Museum Specimens in the County Hall, London, in 1931, is that the larger museums may well assist rural areas by extending to them the use of loan collections, especially of those circulating loan collections which are adapted by their labelling and by their construction for the use of schools and for safe transport from school to school. To encourage the extension of

such services beyond the boundaries proper of certain urban museums, the Carnegie United Kingdom Trust is prepared to give grants, any one of which is not likely to exceed £200.

The Museums Association is closely identified with the scheme, and applications or enquiries concerning these grants should be made to The Secretary, Museums Association, Chaucer House, Malet Place, London, W.C.1.

We would remind our readers in the Colonies that their museums also stand to benefit from the activities of the Museums Association, for the *Museums Journal* states that the Association is now prepared, through its Empire Secretary, at the above address, to receive applications for grants towards museum developments in the Colonies. These grants will be made from a fund of 54,000 dollars placed at the disposal of the Museums Association by the Carnegie Corporation of New York.

No single grant is likely, in the early stages of this interesting and highly-important experiment, to exceed £1,000, and although no limitations are placed upon the purposes for which a grant may be given, there is an understanding that it will be used towards purely scientific purposes, such as investigation of original collections and publication of results, or towards general museum organisation, such as the employment of expert help in reorganising collections and the purchase of cases for organised collections, or for educational work, on behalf of the people and on behalf of the curator himself, so that he may learn by visiting the best museums.

Here again there must be some sort of limitation; but the restrictions are very reasonable. No grant will be given to any museum which has not a qualified curator, whether paid or honorary; and no grant will be given to any museum unless there is definite proof that the authorities concerned intend to continue their active support of the institution.

In these provisions for the museums of the British Isles and of the Colonies, museums have placed before them such opportunity as has never before offered, and such as may not offer again. It is for them to show, by the devising of methods of arrangement and exhibition and of peaceful penetration which will create new links of interest between them and the people, that museums can become effective forces for the instruction and intelligent pleasure of the community, so that no man dare ignore their services. When museums have carried their progress so far, the Carnegie United Kingdom Trust can withdraw, having completed its mission; for from that time onwards public authorities will see to it that the museum is retained in its proper place in the framework of education. But if municipalities and museums allow these opportunities to slip through their grasp would the plain man not be justified in thinking (as some think) that many museums ought to take their place on the stage of life beside the "Sleeping Clergyman"? J. R.

The Engineer and Modern Civilisation*

By SIR FRANK SMITH, K.C.B., SEC.R.S.

REFRIGERATION AND FOOD SUPPLY

TO pass from the prime mover to food, the prime necessity of life, may seem a very big step. Indeed, so far as our food supply is concerned, many may wonder what particularly notable achievements, apart from transport, are to be credited to the engineer.

If we attempt to conjure up a picture of our food supply our view must include not only the produce of our own farms and fisheries, the great wheat fields of Canada, the sheep farms of Australia and New Zealand, the cattle ranches of the Argentine, the orchards of South Africa and other countries, but also the great ships which bring much of the food to our shores, the refrigerated stores in the docks, and in the market, the great chemical factories which turn out fertilisers and the products of a lesser known man who may be described as a biological engineer. To make the picture even more complete we might examine the contents of a grocer's shop with its hundreds of eggs in varying stages of freshness, a portion of Smithfield market with hundreds of carcases of New Zealand lamb, or even a hawker's barrow on a winter's day crammed with fruit which in former times would have been regarded as out of season.

To put a quantitative touch to the picture let us examine the returns of the Board of Trade. In 1932, we find that we imported on an average about one million pounds' worth of food every day. Of those eggs in shells which we saw at the grocers' shop we imported 2,000 millions. Those carcases of lamb we all know come mostly from New Zealand. How many carcases in all New Zealand sent us in 1932 I do not know, but the value of them was more than seven million pounds, and this represents but a small proportion of our imports of meat, which in 1932 were valued at more than 78 million pounds. What of those apples on the hawker's barrow? If they weigh from 3 to 4 to the lb. it is easy to calculate from the figures given by the Board of Trade that about 3,000 millions were imported; and there were about the same number of oranges.

The people of London could not be fed in this way in olden times. In the summer, food was of good quality and usually plentiful; in the winter it was poor and often scarce; sometimes very scarce; meat and fish were kept by curing with salt, and many vegetables such as carrots and turnips were preserved with honey to form a jam.

* *Continued from p.* 129.

During the last fifty or sixty years, and particularly during the last fifteen years, there has been a new outlook on food, and the outlook is in part that of the biologist and in part that of the engineer. Let us for a moment consider that New Zealand mutton in Smithfield Market. There was none such a hundred years ago, or even eighty years ago. It was not because New Zealand could not produce the mutton or because we did not want it; it was because it could not be transported. There was no engineer's ice in those days. In 1860, an attempt was made to bring a cargo of meat from Australia to England. The meat was preserved for as long a time as possible with natural ice, but the ice failed to last through the journey and the meat was thrown overboard. The engineer got over the difficulty; he made ice on the ship, and with this engineer's ice the first cargo of frozen beef and mutton reached us in 1877 from Australia. It may be truly said that there would be no New Zealand mutton eaten in England to-day were it not for the engineer learning how to produce cold by the application of heat. To-day, practically all the ice used for preserving food is engineer's ice, and it is to the engineer that the refrigerating machinery in ships, in the docks, in trains, and in the home is due. In ships alone, the freezing space carrying cold stored produce to Great Britain amounts to about 100 million cubic feet, equivalent to a cold store 20 feet high, 50 feet wide and 20 miles long, and the capacity of the public cold stores of Great Britain is approximately one half of this. Half a million tons of ice are made by the engineers for domestic and commercial land purposes, and three-quarters of a million tons are made for the sea fishing industry.

Let us look at this picture of refrigeration and see how it commenced. Exactly how long cold in the form of ice has been used to preserve food we do not know. Macaulay tells us that a little more than three hundred years ago Francis Bacon on a very cold day in spring bought a fowl and stuffed it with snow. He caught a chill and died about a week afterwards, but before he died he stated in the last letter he ever wrote that the experiment with the snow had succeeded "excellently well".

To the refrigerating engineer, however, the most interesting figures in the background are those of Count Rumford and Joule, whom we see once again demonstrating the convertibility of heat into work, and proving that heat is a mode of motion. It follows directly from these principles that since a particle of water vapour has more energy of motion than a particle of water of the same mass and at the same temperature, that if the vapour is continually removed by a vacuum pump or by absorption by sulphuric acid, and the water continues to give off vapour, that is, to evaporate, it will not only cool, but ultimately it will freeze owing to the loss of energy which has been transferred to the vapour. Here is a simple freezing machine based on the Rumford-Joule principle.

In the case of the prime mover, the working medium may be one of many fluids. It is usually steam, and in the internal combustion engine it is what Sir Dugald Clerk called 'flame'. Similarly, with the refrigerating machine, practically any medium which is liquid at ordinary temperatures and has a reasonable vapour pressure may be used, but for efficient and economical working the choice is limited to such fluids as ammonia, sulphurous acid, ether and carbon dioxide.

As with the steam engine, the first refrigerating machine was an atmospheric one and the medium was water and its vapour. It was made by William Cullen, who used a vacuum pump to remove the vapour. More and more heat was given up by the water to replenish the vapour above its surface, and eventually the water froze. Later, Leslie invented the sulphuric acid absorption machine which was developed by Carre and Windhausen.

The development of the steam engine was in the direction of increased pressure and that of the refrigerating machine was in a corresponding direction. It follows that if work is done on a gas by compressing it heat is produced; the heated gas may be allowed to cool or it may be cooled artificially. When it is cool it is allowed to expand; in the process it does work, loses heat and falls in temperature. A repetition of this cycle of changes produces a lower temperature than before, and a rapid series of such cycles constitutes the modern compression refrigerating machine.

I do not propose to deal with the developments of refrigerating machinery, but as some indication of the growth of the engineer's importance in this field it is of interest to note that in the United States alone there are more than 150,000 refrigerated cars, and in that country more than 8 million tons of meat are submitted to mechanical refrigeration before reaching the consumer. In Great Britain our debt to the refrigerating engineer is more simply expressed by saying that on an average every person consumes per day 6 oz. of food which has been subjected to refrigeration. As a nation, I suppose we produce little ice-cream compared with the United States of America, but in 1933 the total consumption of ice-cream was about 30 million gallons.

To the engineer there is, however, an even more interesting feature of food preservation than that of refrigeration. If we go back to the hawker's barrow the biologist will tell us that those apples are alive and to freeze them means death. When frozen apples are thawed they become pulp and are only fit for jam. Like other kinds of fruit, the apple is a living structure whose preservation demands that it shall be kept alive. Sir William Hardy described the apple as a biological internal combustion engine with a large store of available fuel, and to keep it alive the external conditions must be such as not to stop it functioning in a normal fashion. The apple takes in oxygen from the air just as an internal combustion engine does, and it gives out carbon dioxide and other products

as a result of the chemical changes taking place. I do not wish to suggest that there is a close comparison between the internal combustion engine invented by man and that far more perfect one designed by Nature for the apple, but there are parallels of interest. Conditionally that there is an ample supply of fuel—as there is in an apple—an internal combustion engine will consume that fuel faster, get hotter, and wear itself out more quickly the greater the supply of oxygen. The same is largely true in the case of the apple; the rapidity of change is largely dependent on the atmosphere in which it is kept; if the atmosphere surrounding the apple contains too much carbon dioxide the apple will die, and decay known as brown heart sets in. If, on the other hand, the carbon dioxide is maintained at a somewhat higher rate than that present in a normal atmosphere the rate of change is delayed and the apple loses weight at a reduced rate. This very roughly is the basis of the method of preservation known as gas storage. The fruit subject to a certain amount of refrigeration is contained in an atmosphere containing a certain percentage of carbon dioxide, the optimum percentage like the optimum temperature varying for different kinds of apples.

It is a simple method and presents no great difficulty to the engineer. Temperature and carbon dioxide recorders must be installed, and there must be some cold storage arrangements. The carbon dioxide is supplied by the apples themselves; and the engineer has devised arrangements which ensure that the concentration shall not rise to a level which will kill the apples. In Great Britain during the coming season there will be about thirty of these gas stores and very good results are being obtained. Unfortunately the best temperature of storage of apples varies with the variety; thus for Newton Wonder it is 1° C. and for King Pippin 4·5° C. and the best conditions for each variety have to be worked out.

Let us now consider the engineer's task in 1932 when he brought here 84,000 tons of apples from Australia and 28,000 tons from New Zealand in refrigerated ships. Roughly speaking, apples keep best at about 3° C., and the ship's engineer had to keep each ship's hold, packed with boxes of fruit, at about that temperature. To the walls of each hold refrigerating pipes were fixed and through these pipes cold brine was pumped to carry off the heat. Each unit of the cargo was alive and giving off heat, water and carbon dioxide, and the refrigerating plant had not only to absorb all the heat passing into the hold from external sources but also absorb that produced by the cargo. It was important therefore to know the amount of heat produced per hour by the apples. The heat produced rises with the temperature of storage, and an apple attacked by fungus gives off much more carbon dioxide and much more heat. It is due to the engineer's skill in controlling the average temperature, in preventing large temperature gradients and in arranging for appropriate ventilation to prevent an excessive accumulation of carbon dioxide at any point that such large consignments of apples can be shipped to us every year from Australia and New Zealand in comparative safety. Of course, disasters do occur at times, and suffocation by carbon dioxide has cost in a single year more than one hundred thousand pounds.

I have not time to tell you about the engineer's share in the care and transport of other fruits, but in 1932 more than 100,000 tons of oranges and 7 million bunches of bananas were brought here in refrigerated ships. It may therefore be said with truth that without refrigerating engineers we should have neither plenty of fruit nor much of good quality.

Normally, one example, such as that of the apple, should suffice to show the part the engineer has played in preserving food, but during the past two years there has been a development in the meat trade which promises to be of great importance.

Notwithstanding its apparent advantages, freezing has been applied to very few foodstuffs with complete success. Lamb, some kinds of fish and butter may be frozen with success, but freezing has been applied to beef with only partial success. It has been urged that freezing entails the separation in the tissues of a solid ice phase and that in the complex structure of food mere mechanical shattering will account for the damage. While it is certain that this is not the complete story, the damage done to beef by complete freezing is such that when the thawed carcase is cut the flesh is wet and a red fluid drips from it. Chilled beef, that is, beef kept a little above the freezing point, undergoes no such change, and it is not surprising therefore that of the 560,000 tons of beef we imported in refrigerated ships in 1932 about 80 per cent was chilled. Of the frozen beef, Australia sent us 47,000 tons; of the chilled beef none. The reason for this is that chilled carcases of beef can be maintained in good condition for only about four weeks, and that suffices to bring them from South America but not from Australia.

The biological engineer has, however, made the discovery that if chilled beef is kept in an atmosphere containing 10 per cent of carbon dioxide the growth of moulds is inhibited and the 'life' of chilled beef is increased to such an extent that after a 65 days' voyage from Australia in a 10 per cent carbon dioxide chilled atmosphere beef might be delivered in London free from moulds and in good condition. In the *Times* Trade and Engineering Supplement of May 19 last the engineer no doubt read with interest that the steamship companies are alive to this method of transportation, and that three ships of one company alone are being fitted with carbon dioxide chambers. Thus the engineer with his refrigerating machines and automatic regulation of the carbon dioxide content of the chambers has enabled increased supplies of chilled beef to be placed at the disposal of the consumer of Great Britain. He has, in fact, increased both quantity and quality.

Obituary

Dr. L. Cockayne, c.m.g., f.r.s.

The death, in Wellington, of Dr. Leonard Cockayne early in July at the age of seventy-nine years is recorded with deep regret.

Dr. Cockayne was born in Derbyshire in 1855, the youngest son of the late Mr. W. Cockayne. He went to Australia in 1879 and to New Zealand in 1880. At first he was engaged in teaching, but in 1887 he commenced his botanical exploration which he continued almost to the time of his death. The geographical position of the Dominion must in itself make a study of its flora and vegetation of supreme importance to all interested in the distribution of plants. Its richly endemic flora has attracted the attention of botanists from the time of Banks and Solander (1769–70) to the present day. Thanks to the activity of a large number of collectors, many of whom were, or are, resident in New Zealand, its flora has been relatively well investigated.

Cockayne's great contribution to New Zealand botany was his pioneer work in the ecological study of the vegetation, and the problems of plant evolution as presented by the native flora. His synecological publications commenced in 1899 with a paper on the burning and regeneration of subalpine scrub (*Trans. New Zeal. Inst.*, 31, 398; 1899), although he had already published accounts of the freezing of New Zealand alpine plants and of the seedling forms of New Zealand phanerogams. The titles of the scores of papers published by Cockayne indicate both the wide and original nature of his research and something of the stimulus he gave to the study of plant-life in the southern hemisphere. His extensive botanical travels in the Dominion and its dependencies gave him that wide knowledge which enabled him to write his *magnum opus*—"The Vegetation of New Zealand"—which was published, as vol. 14 of Engler and Drude's "Die Vegetation der Erde", in 1921. The first edition of this was disposed of within one year of its appearance, and a second edition was published in 1928.

Cockayne's special interests were undoubtedly centred in the study of plants as living organisms, and hence in the major problems of biology. Apart from vegetational studies he delighted in considering plant morphology from a dynamic point of view. His early investigation into the form of seedlings, his research on the variation of leaves, the significance of spines, and his field-studies on hybridism (carried on latterly in conjunction with Dr. H. H. Allan), indicate not only the intensive and extensive nature of his research, but also his desire to answer the how and wherefore of every problem connected with the botany of his adopted country.

In 1912, Cockayne published an important paper under the title "Observations concerning Evolution derived from Ecological Studies in New Zealand" (*Trans. New Zeal. Inst.*, 44, 1; 1912). This was followed by various other papers in which the evolutionary aspect was stressed. The significance of hybridisation as the immediate cause of polymorphism, which is a conspicuous feature of a very large number of genera in the New Zealand flora, was urged with justified conviction from the results of detailed field-studies of 'hybrid swarms'. His criticisms of taxonomic practice have, like much of his other work, an application far outside the study of New Zealand plants, and should be considered by all who believe in the fundamental importance of taxonomy.

Two other aspects of Cockayne's life-work must be mentioned. It was, perhaps, his early teaching experience which enabled him to produce a book so admirably suited as an introduction to New Zealand plant ecology as "New Zealand Plants and their Story". In this work the underlying idea is that of "the plants telling their own story", but the interpretation of this story discloses the master mind. A remarkable feature of the book is the simplicity of its language with its avoidance of the absurdities usually associated with over-popularisation. It is for New Zealanders themselves to estimate and acknowledge what they owe to Cockayne as a teacher in that broad sense of the term as one who by inspiration and example leads the way. It is obvious to others that the influence of such a textbook, of wide appeal, well produced and illustrated and yet of low price, must continue through many generations.

The application of ecology to economic problems was another feature of much of Cockayne's research. Forests, sand-dunes and pastures, especially the last, were investigated with the view of preserving, stabilising and improving them. That his own words—"it seems clear that New Zealand is attempting to do its economic ecological duty" (Report Imperial Botanical Congress, p. 266; 1925)—are true, is mainly due to Cockayne himself. His wide botanical knowledge made his advice of inestimable value on the Royal Commission on Forestry (1913), the Cawthron Commission (1919), the Royal Pastoral Commission (1920), as well as in his position of honorary botanist to the New Zealand State Forest Service.

Numerous honours were bestowed on Cockayne—the Hector Medal and Prize, the Hutton Memorial Prize, the Mueller Memorial Medal and Prize, the Darwin Medal of the Royal Society (1928), the Veitch Memorial Medal (1932). He was elected a fellow of the Royal Society in 1912 and created C.M.G. in 1929. He was a fellow and past president (1918–19) of the New Zealand Institute and in 1932 he received the honorary degree of D.Sc., New Zealand. The British Ecological Society fittingly recognised the importance of his contributions to ecological botany by making him an honorary member in 1933.

W. B. Turrill.

PROF. B. D. STEELE, F.R.S.

THE death occurred at Brisbane on April 12 at the early age of sixty-three years of Bertram Dillon Steele, emeritus professor of chemistry in the University of Queensland. Prof. Steele was forced by ill-health to relinquish active teaching in 1928 and was given the title of emeritus professor in 1930.

Prof. Steele was brought up in England, but went to Australia with his family in early youth. First qualifying as a pharmacist, he later took his science degree in the University of Melbourne. He returned to Europe in 1899 with an 1851 Exhibition Scholarship. Following this, he held posts in McGill University, Montreal, and Heriot-Watt College, Edinburgh. He returned to the University of Melbourne as lecturer in chemistry in 1905. In 1910 he was appointed as first holder of the chair of chemistry in the University of Queensland. His scientific work in connexion with the determination of transport numbers of electrolytes and the electro-chemistry of non-aqueous solutions was carried out before his return to Australia. After his return to Melbourne, he designed in conjunction with Kerr Grant the very sensitive micro-balance later used by Ramsay and Gray for determining the density of radon.

The duties associated with a chair in a new university, however, left Prof. Steele little time for scientific work in his later life. He acted as first president of the Board of Faculties of the University, which was largely responsible for the organisation of the institution. Perhaps his most valuable contribution to public welfare in Queensland was his association as chairman with Government Commissions for the control of the prickly pear. As a result of the activities of a Royal Commission, the pear, which was formerly encroaching on hundreds of thousands of acres of good land annually, is now actually being driven backwards.

During the War, Prof. Steele proceeded to England on leave from his University and entered the service of the Ministry of Munitions. He was responsible, among other activities, for the design and successful running of a synthetic phenol factory at Ellesmere Port, Cheshire.

PROF. GEORGE CARY COMSTOCK, emeritus director of the Washburn Observatory and professor of astronomy in the University of Wisconsin, formerly dean of the Graduate School, died on May 11, aged seventy-nine years. He was known for his determination of the constant of aberration, for studies of atmospheric refraction, for long-continued work on double stars, and especially for one of the first determinations of the proper motions of faint stars.

WE regret to announce the following deaths:

Prof. J. M. Aldrich, associate curator of insects in the U.S. National Museum, an authority on the Diptera, on May 27, aged sixty-eight years.

Prof. Harriet W. Bigelow, professor of astronomy at Smith College, Northampton, U.S.A., known for her work on comets and the positions of stars, on June 29, aged sixty-four years.

Prof. M. S. Pembrey, F.R.S., formerly professor of physiology in the University of London, known for his work on respiration, on July 23, aged sixty-eight years.

News and Views

Lessons of the Drought

THE *Times* Trade and Engineering Supplement of July 28 contains a special section devoted to a consideration of "Water Economy and Supply". In view of the continued predominance of the topic of the drought, the appearance of a symposium of the opinions of various competent authorities, including engineers and men of science, on the subject is undoubtedly opportune and appropriate, though it appears that the publishers, when the idea was first mooted, entertained misgivings lest a change of weather might destroy the basis of the number before its publication. The first article on "Lessons of the Drought", by Sir E. Hilton Young, the Minister of Health, is generally of the nature of a reassuring statement calculated to allay public anxiety. "There is," he says, "great need for care and attention to the situation, but none for alarm." He counsels economy in the use of water "where reserves are not abundant", and recommends water undertakers to look ahead and "assume that the drought will continue in large measure until the rains of November and December and that even then there may not be more rain than last year, when it was much below the normal". The Water Shortage Act, passed in May last, has proved of signal service in enabling water authorities to augment their supplies.

SIR HILTON YOUNG discusses the question of future water policy, and, while conceding that measures could be taken to obviate economies during even severe drought, feels that the cost would be inordinately great and too heavy for the rate-payer to bear. It is, he says, a matter for careful thought how far to go in increasing permanently the cost of water in order to ensure against very exceptional scarcity. On the subject of lessons from the drought, survey and distribution indicate, in his opinion, the most fruitful field for improvement, but the survey he has in mind is not the survey now being pressingly urged on the Government by the British Association and the Institution of Civil Engineers. It is merely "that water undertakers should form as accurate an estimate as they can of their future needs, bearing in

mind the trend towards increase of consumption as well as the trend of the population". It is shown in the leading article of this issue of NATURE that this view of the situation is quite inadequate, and that something much more fundamental and drastic is required to meet the ever-increasing demands on the water resources of the country. Sir Hilton closes his contribution with a note on rural supplies in which he says that schemes costing a million sterling are "already in sight" and many more schemes are on the way.

Water Resources and their Administration

IN a succeeding article on "National Water Resources and the Need for a Comprehensive Survey", Mr. R. B. Dunwoody takes a much sounder and more practical view of the matter, recalling the investigation of the Royal Commission (1906–1911) on Canals and Waterways, which showed "a striking absence of statistical information as to the flows of rivers and streams, and consequently of the water available in different parts of the country". On the completion of the investigation, as secretary of the Commission, he submitted in 1911 to the President of the Local Government Board a scheme for a comprehensive survey of the water supplies of England and Wales. Considerable extracts are quoted from the memorandum, all indicating that it has much in common with the proposals for a survey now being urged on the Government. Mr. Clemesha Smith, in his article on "Regional Water Supplies", presses the need for co-ordination. Amplifying the policy of the appointment in several parts of the country of regional advisory committees, he considers that committees in respect of suitable areas should be set up covering the whole of England and Wales. He outlines the functions of the two sets of bodies he proposes, as follows: (*a*) regional committees, consisting of representatives of authorities, charged with the duty of supplying water for domestic purposes, empowered to demand the necessary information and able to raise funds to enable them to check statistics and examine and put forward proposals relating to water supply; and (*b*) water commissions, the duties of which should include considering the tabulated statistics prepared by the regional committees and advising them on the schemes submitted and as to improvements, amalgamations and variations. Mr. Smith emphasises that if problems of water supply are to be solved on rational lines, the first step must be the accumulation of accurate information, and the second the examination and consideration of the facts by recognised authorities.

The 24-Hour Time System

THE question of the 24-hour time system was raised in the House of Lords on July 27 by an inquiry from Lord Lamington whether a report on the working of this system by the British Broadcasting Corporation would be laid on the table of the House. Lord Templemore, speaking for the Government, said that no formal report has yet been received from the Corporation, but the Postmaster-General understands that the Corporation will, before very long, make a statement on the subject. In the light of information given by the Corporation, the Government has had under consideration the question of extending the use of the 24-hour method of expressing time. Lord Templemore added that he was authorised to say that the Government, after carefully reviewing the whole question of adopting the 24-hour notation for official purposes, has come to the conclusion that there is still no sufficient evidence of a general public demand for any change to justify it in taking any action in the matter.

The British Broadcasting Corporation Experiment

THE B.B.C. has stated that there has been no evidence of either widespread opposition or support to the experimental use by it of the 24-hour system. An announcement will be made in due course to what extent, if at all, it will continue the use of the system for other than internal purposes. The experiment was intended to familiarise the public with the 24-hour notation, but has been widely misrepresented in a certain section of the Press as an attempt to impose the 24-hour system for the purposes of everyday life. One paper published photographs of the well-known 24-hour clock at the gate of Greenwich Observatory, and of an ordinary 12-hour dial, and held what was stated to be a plebiscite on the question of the 24-hour system. The voting paper required a cross to be placed against whichever dial was preferred, and the result was announced as a large majority against the 24-hour system. An increasing number of engineering, electrical and other organisations, which are in continuous operation by day and by night, are using the 24-hour system owing to its conveniences and no difficulties of any sort have arisen from its use. The use of the system by the B.B.C. should have educated the public sufficiently for time-tables using the 24-hour notation to be understood. It is to be hoped that the railway companies and road transport organisations will not wait any longer for a Government lead, but that they will introduce the 24-hour system in their time-tables by mutual agreement.

Scientific Research on Works of Art

THE forthcoming academic year will witness an important new development at the Courtauld Institute of Art, University of London. Since its inception, the Institute, which is under the directorship of Prof. W. G. Constable, has recognised the necessity for systematic and scientific research into the physical constitution of works of art: and a new Department and Laboratory of Scientific Research has now been brought into being at the Institute, at which such lines of investigation will be actively pursued. Such problems as the nature of the changes undergone by works of art on cleaning and renovation, and on exposure to atmospheric moisture and light, and the advantages of different methods of treating 'diseases' of works of art, will receive systematic investigation. So far, work in Great Britain has been carried out for the most part

by private investigators, though various laboratories abroad, such as those at the Fogg Art Museum, Harvard University, and at the Technical High School, Munich, have attacked the subject systematically. One of the main aims of the new Department will be the co-ordination of its results, with the view of publication, with these obtained in other centres, with which close relations will be cultivated. The head of the new Department and Laboratory is Dr. P. D. Ritchie, who will have the benefit of the knowledge and experience of a permanent advisory committee consisting of a number of prominent men of science and art experts. It is hoped that the Department will be in active operation by October, though no problems can be dealt with before that date.

International Anthropology and Ethnology

The first session of the International Congress of Anthropological and Ethnological Sciences was opened by H.R.H. Prince George at University College, London, on July 30. The Congress is the outcome of a movement initiated more than twenty years ago, when in 1912, after the London Meeting of the International Congress of Americanists, a small international committee was appointed by the Royal Anthropological Institute to organise such a Congress. As a result of no little negotiation and correspondence, it was then arranged that a Congress should take place in 1916. Owing to the War, the Congress did not meet, and the proposal fell into abeyance, until in the course of the discussion of arrangements for the International Congress of Prehistoric and Protohistoric Sciences, which met in London in 1932, it emerged that the need for an international meeting ground for the discussion of the problems of ethnology was urgently felt. Experience gained by the inclusion of an ethnological section at the archæological congresses organised after the War by the French Institut d'Anthropologie had proved to the satisfaction of most of those who had taken part that nothing short of an independent congress would prove satisfactory. Many, with good reason, were reluctant to add to the already large number of international scientific congresses; but the almost overwhelmingly heavy programme submitted at this first session is a sufficient proof of the wisdom of the decision. Not merely the number and the variety of the communications, but also the number of joint discussions between two or more sections—thirteen discussions in all—shows that, even within the limits laid down by those responsible for the organisation of the programme, the debatable questions in ethnology, which it is felt desirable to ventilate by open discussion, are numerous.

On the opening, the Congress numbered more than a thousand members, and delegates from no less than forty-two different countries were present when Lord Onslow delivered his presidential address at the inaugural meeting. America, both North and South, was well represented, owing to the approximation of the date to that of the forthcoming European session of the International Congress of Americanists later in the month. This is a coincidence which the promoters had in view as a regular recurrence every four years, when the present year was chosen to initiate the series. As the presence of so many foreign anthropologists of distinction is not likely to occur again for a long time to come, every effort had been made to show them as much as possible of the ethnographical and archæological treasures of our public and private collections, while a number of special exhibits had been arranged. Among these, one of the most striking was the exhibit of material brought back by Miss G. Caton-Thompson and Miss E. W. Gardiner from their investigations on behalf of the Royal Anthropological Institute at El Khargeh in Egypt. The exhibits illustrate the classification of stone implements into seven periods of the Stone Age, the fossil mound springs which have demonstrated the existence of two pluvial periods, and have afforded evidence not only of the character of the water supply but have also provided data bearing on the relation of prehistoric tools to fossil vegetation, of which the exact period and determination had hitherto defeated investigators. This exhibition will be on view to the public after the Congress for a period of three months. The British Museum also arranged an exhibit especially for American visitors, which included the famous Maudslay Maya plaster casts and examples of the antiquities obtained by the Museum's expeditions to British Honduras. Special interest also attached to the prehistoric pottery brought by Sir Aurel Stein from Baluchistan and Persia, in view of the subject of the Huxley Memorial Lecture, which he delivered on July 31, before the Congress.

Exhibits from Tell Duweir, Palestine

In order to afford those attending the International Congress of Anthropological Sciences in London an opportunity of viewing the antiquities from Tell Duweir, the Exhibition of the Wellcome Archæological Research Expedition in the rooms of the Palestine Exploration Fund, Manchester Square, remained open until August 3. Much interest was aroused by the exhibits, the inscribed ewer naturally attracting a great deal of attention. Further fragments of the ewer have been found among the material brought from Palestine, and these have added definition to its form, while the line of decoration is now almost continuous. A card exhibited with the ewer gave the alternative readings which have been proposed. Even more impressive were the relics from the sanctuary shrine in the fosse, of which the destruction is dated by the Rameses II plaque as not earlier than the first half of the thirteenth century B.C. The preservation *in situ*, and in some instances intact, of the appointments of the shrine gives the find a unique character. These objects, including the benches for offerings, the libation jar and offerings bin and the like, were displayed in and around a model reconstructed from squeezes. This exact record of a remarkable cult-object reflects the greatest credit on the initiative and technical skill of the members of the expedition.

THE significance, in an archæological sense, of the shrine and of its extra-mural location as a non-urban cult, was much enhanced by the accompanying material, both that from the floor, such as the remains of the ivory toilet appliances, and that from the adjacent waste-heap, among the latter, more particularly, by the ivory carvings and inlay. The occurrence of an inscribed sherd, on which one character is conjecturally read *Aton*, if it should prove to be decipherable, may serve to throw an important light on the position of the reformed religion outside Egypt; while the ivories afford material for examination and discussion of no little moment for an understanding of the relations of artistic development in Egypt and Palestine. The resemblance of the ivory incense vase in the form of a female with a spoon attached to the head to that depicted in the British Museum fresco of *circa* 1415 B.C. from the tomb of Sebekhetep as being carried by an Asiatic tributary lends strong support to the view put forward by Mr. J. L. Starkey in his lecture at the Palestine Exploration Fund that these specimens afford evidence for the existence of a local school of craftsmen, of which later examples are to be seen in the products of Samaria. Of the remaining exhibits, little need be said. Their importance, especially in the instance of the pottery and metal objects from the Copper Age cave-dwellings and cemetery, was patent. The peculiar form of the copper darts, or javelin points, calls aloud for an analogy, which some technologist at the Anthropologican Congress should have been able to furnish. This, though a lesser problem, is by no means the least intriguing of the material brought back by what must be judged by its material to have been a most successful expedition.

Climate and Health

THE one hundred and second annual meeting of the British Medical Association was held at Bournemouth last week under the presidency of Dr. S. Watson Smith, who took as the subject of his presidential address "Climate and Health". In the choice of this subject, he said, Bournemouth seemed a fitting place from which to speak. There are those who believe climate to be the most influential of the natural causes controlling the destinies of mankind. Apart from the secondary causes, biologically concerned, such as temperature, humidity, altitude, winds, soils, etc., the chief factor governing climate would seem to be insolation. The world distribution of sunlight, and the resulting variations of temperature, appear to determine the differences between coastal, plain, and hill climates; as also such matters as diversity of colour types of man. The importance of sunlight to life and health cannot be over-estimated, but it is desirable to impress upon the community that, whilst the sun is our greatest natural friend, it can, if regarded with disrespect, become an equally potent foe; for an excessive exposure to light rays, whether natural or artificial, not only entails fatigue and exhaustion, but also produces early degeneration of the skin. In the British Isles, all gradations exist between the bracing and tonic, and the sedative and relaxing, climates, and a careful study of an invalid's general state of health and mental traits should be made before recommending the suitable place.

Medicinal Baths and Springs

WATERS and baths are to be looked upon as factors accessory to climate, over which they may have a dominating therapeutic influence. Spas frequently specialise in the treatment of particular ailments, and should be classified not only according to type of climate, but also upon their therapeutic indications. Whatever the chemistry of medicinal waters, their effects are several and complex. The biochemical action of medicinal waters is perhaps of greater moment than hitherto generally believed. Calcium, iodine, bromine, iron, salines, sulphur—all occur in readily assimilable form as a dilute solution of electrolyte in different spa waters, thereby providing a means of restoring to the individual what has been lost by dysfunction and disease. Medicinal springs and baths should be under a public control, ensuring regular analyses, purity, and the preservation of the natural amenities. These resorts should also provide a wide range of electrical, physical, and other accessory means of treatment for the re-education of body functions and structures. Britain being a most favoured land as to spas and health resorts, it is now generally recognised that there is seldom, if ever, medical necessity to winter abroad, unless it be to obtain by altitude, or by dry or sea air, a suitable climate for the tuberculous or asthmatic. On the other hand, there is no doubt that Continental or foreign travel, giving a complete change to body and mind, may often be beneficial in cases of mental strain and nervous trouble, producing a detachment from insular home prejudices, and encouraging an interchange of visits and courtesies from country to country.

Control of the Whaling Industry

THE Whaling Industry (Regulation) Bill, which passed almost unobserved through all its stages in the closing days of the parliamentary session, gives effect to one of the most hopeful attempts yet made to secure international action for the protection of animals. The great destruction of whales in antarctic seas has caused anxiety not only to those who would deplore the possible extermination of those great creatures, but also to those concerned for the future of the industry itself. In recent years, the use of 'floating factories', which can operate outside territorial waters, has rendered it impossible for individual Governments to control the industry in the way in which it could be controlled when the factories were on land. By a convention signed in 1931, the Governments represented on the League of Nations at Geneva bound themselves to introduce a system of licensing for all whaling ships registered in their respective countries, and to attach to the licences conditions giving partial or complete protection to certain species of whales. Several other nations have already ratified this convention by passing the

necessary legislation, and some surprise has been expressed abroad at the long delay in obtaining ratification by Great Britain.

THE Bill, which is about to pass into law, like that which has been passed in Norway, actually goes beyond the terms of the convention in one or two respects. Not only does it prohibit altogether the capture of what are known as 'Right' whales and of whales below certain sizes, to be prescribed for the different species, as well as of females accompanied by their young, but it also gives power to the licensing authority to establish a close season should this be deemed advisable. Furthermore, while the Geneva convention applies only to the whalebone whales, the present Bill gives authority for extending its provisions to any other species of whale, should such extension be internationally agreed upon. This clause might possibly become of great importance if, at any time, there should be a revival of the sperm whale fishery.

Recent Acquisitions at the British Museum

THE Department of Zoology has received as a donation from the Rowland Ward Trustees a crab-eating opossum (*Didelphys cancrivorus*) and a rat-tailed opossum (*Metachirus nudicaudatus*). A rare tree-kangaroo (*Dendrolagus ursinus*) from New Guinea is the gift of Sir Frank Colyer. The Study Collection has been enriched through the gift from Col. J. Hamilton Leigh of a collection of fifty mammals, mostly from Scotland. The most important specimens in this collection are a series of Scottish wild cats. The Department of Entomology has received as a gift from Dr. G. Arnold, Director of the Rhodesian Museum, the very valuable collection of ants which formed the basis of his "Monograph of the Formicidæ of South Africa" published in the *Annals of the South African Museum* (766 pp., 9 plates, 1915–1924). The collection contains upwards of 7,000 specimens, comprising examples of 653 species many of which have hitherto been unrepresented in the Museum. In the economic life of most tropical countries ants are an important factor, principally in the control of other insects, especially the so-called white ants. In this connexion, Dr. Arnold states that the food of one large group of ants consists of 80 per cent at least of these very serious pests. The Department of Botany has purchased sixty-four bundles of plants from the Saffron Walden Museum. There are about 3,500 foreign specimens many of which were purchased by W. Gibson at A. B. Lambert's sale. The most important of these are about 150 plants collected by the Rev. E. D. Clarke on his travels in the Crimea, Greece, Troy and elsewhere. It is probable that additional historical material will be recognised, as the collection is worked through.

FRAGMENTS weighing 4½ lb. of meteoric stones which fell on April 8, 1932, near Temiki on the north-eastern border of the Gash delta (about 250 miles east of Khartoum) have been presented to the Department of Minerals by the Director of the Geological Survey of the Anglo-Egyptian Sudan. This is the first meteorite to be recorded from the Sudan, and it appears to be of an unusual type. Pieces of two notable iron meteorites, one from the meteorite crater recently recognised near Odessa in Texas, and the other from the 15-ton mass at Mbosi in Tanganyika Territory have been presented respectively by Mr. George C. Fraser of New York and Mr. H. V. B. Lloyd-Philipps. The latter has also given a rich specimen of gold quartz from a newly discovered reef in the Lupa goldfield, Tanganyika Territory. Gold specimens from three mines in the Tati district, Bechuanaland Protectorate, and a nugget of platinum from Abyssinia, have been given by Mr. Hugh S. Gordon. Metajarlite, a new mineral from Greenland, is presented by Dr. Richard Bøgvad of Copenhagen, and lusakite, a new cobalt mineral named after the new capital of Northern Rhodesia, by Mr. A. C. Skerl. A faceted gem of olivine from Burma, of a rich colour and weighing 101·75 carats, and some tektites 'rizalites', recently discovered in the Philippine Islands, and of unknown origin, have been purchased.

Liver Rot and the Drought

THE Ministry of Agriculture and Fisheries points out that, as a result of the prolonged drought, the breeding places of the water-snail which is responsible for the early stages of development of the liver fluke, which causes 'liver rot' of cattle and sheep, have been considerably reduced, large areas of wet land having dried and only small wet patches and pools left. An opportunity is thus afforded for taking decisive measures for the eradication of the liver fluke from the farm. It is recommended that the remaining haunts of the snail should be dressed with a mixture of finely powdered bluestone and dry sand, in the proportion of 1 to 4, at the rate of one-quarter to one-half hundredweight to the acre. A second dressing should be applied, if possible, after an interval of three weeks, animals being kept away from the treated ground until after rain has fallen. A further measure is to treat all adult sheep with carbon tetrachloride or with extract of male fern, which will expel any mature flukes the animals may be carrying. Further particulars are given in Leaflet No. 89, which may be obtained free of charge from the Ministry, 10 Whitehall Place, S.W.1.

American Ascent into the Stratosphere

THE ascent of an observation balloon into the stratosphere, organised by the National Geographic Society and the U.S. Army Air Corps, described in NATURE of July 28, p. 132, took place over Rapid City, North Dakota, on July 29; but, after rising 60,000 ft., the balloon ripped open and dropped to earth. The pilot, Major W. E. Kepner, and the observers, Capt. A. W. Stevens and Capt. O. A. Anderson, however, were saved by means of parachutes. The gondola, with the remnants of the balloon, fell into a field near Loomis, Nebraska. According to the *Times* report, it was much damaged, but most of the scientific instruments escaped harm.

New Gliding Record

According to a *Times* correspondent, the world's long-distance record for motorless flights, set up on July 27 by Herr Wolfgang Hirth, who flew to Görlitz, in Silesia, about 212 miles, in six hours was beaten by Herr Heini Dittmar, of Darmstadt, on July 29. Leaving the Wasser Kuppe at 11.30 a.m., Dittmar reached Liban, in Czechoslovakia, about 235 miles distant, at 6.30 p.m. It was Herr Dittmar's first flight on a new type of glider called the Fafnir No. 2, newly built by the Research Institute for Motorless Flying at Darmstadt.

Indian Research Expedition

It is announced that an expedition, of which Dr. Quaritch Wales is field director, will leave England for India in October next for the purpose of archæological exploration in Lower Burma and Siam. His Highness the Maharajah Gaekwar of Baroda has contributed £500 towards the expenses of the expedition, which will be known as the Gaekwar of Baroda Greater Indian Research Expedition. The work of organisation has been in the hands of a small committee of the Royal Asiatic Society, the India Society, and the School of Oriental Studies, under the chairmanship of Sir Francis Younghusband. The area which the expedition proposes to explore is one of the few districts of Further India and beyond which is still unexplored, and it may be anticipated that the expedition, under the leadership of Dr. Wales, who has already done valuable work in Siam, will yield material which will throw light on artistic and religious development in Further India and Siam and the cultural relations of these countries to the art, culture and religions of ancient India.

Sixteen Element Oscillograph

In research into electrical engineering problems, the analysis of circuit performance and of the related physical phenomena frequently demands the simultaneous recording in correct time relationship of a large number of transient electrical quantities. The Research Department of the Metropolitan-Vickers Electrical Co. Ltd. has recently completed the design and construction of an electromagnetic oscillograph for recording no less than sixteen quantities simultaneously on a single film. Films up to 12 in. wide and 36 in. long may be used. The operation of the oscillograph is initiated automatically. The instrument requires the attention of one person only.

Mendeléeff Periodic Law

Referring to Prof. B. N. Menschutkin's letter in Nature of June 23, Dr. G. Rudorf, 46, Lanchester Road, Highgate, N.6, writes to point out that German translations of Mendeléeff's papers are readily available in Ostwald's "Klassiker" (No. 68). A German translation of Mendeléeff's second long paper also forms part of supplement vol. 8 (1871) of Liebigs *Annalen*. Mendeléeff published a third table in 1880 (*Ber. chem. Ges.*, vol. 13, p. 1796).

Announcements

At a special meeting of the Trustees of the Carnegie Trust for the Universities of Scotland held in London on July 27, Sir Arthur Rose was appointed chairman of the Trust in succession to the late Lord Sands.

The City of Leicester has published a guide to the works in its libraries dealing with science and its applications. The list is a classified catalogue of 65 pages, and contains a selection of the more modern books, and those considered by the compilers as likely to be of greatest help to serious readers.

At a meeting of the Royal College of Physicians of London on July 26 the following appointments were announced: Sir Henry Dale, as Harveian orator, 1935 (the forthcoming Harveian oration in October next will be delivered by Dr. James Collier); Dr. Daniel T. Davies as Bradshaw lecturer, 1935; Dr. J. S. Bolton as Lumleian lecturer, 1935; Dr. A. A. Moncrieff as Goulstonian lecturer, 1935; Dr. J. D. Rolleston as FitzPatrick lecturer, 1935; Dr. C. R. Harington as Oliver-Sharpey lecturer, 1935; Dr. C. G. Seligman as Lloyd Roberts lecturer, 1935; and Sir Bernard Spilsbury as Croonian lecturer, 1936. The Murchison scholarship was awarded to Stanley G. Browne, of King's College Hospital Medical School.

Applications are invited for the following appointments, on or before the dates mentioned:—A professor of physics in the Royal School of Engineering, Giza—The Vice-Principal, c/o The Director, Egyptian Education Office, 39, Victoria Street, London, S.W.1 (Aug. 7). A civilian education officer in the Royal Air Force Educational Service—The Secretary (A.E.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (Aug. 10). An inspector for the purposes of the Diseases of Animals Act, 1894–1927 in the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (Aug. 13). An assistant in the Electrical Engineering Department of the Coventry Technical College—The Director of Education, Council House, Coventry (Aug. 14). An adviser in agricultural zoology in the University College of South Wales and Monmouthshire, Cardiff—The Registrar (Sept. 1). A director of research of the Research and Standardization Committee of the Institution of Automobile Engineers—The Secretary, Watergate House, York Buildings, London, W.C.2 (Sept. 1). An engineer and ship surveyor—The Senior Staff Officer, Establishment Department (Mercantile Marine Branch), Board of Trade, Great George Street, London, S.W.1 (Sept. 12). Readers in medicine, surgery, obstetrics and gynæcology, pathological chemistry and bacteriology at the British Post-Graduate Medical School—The Academic Registrar, University of London, S.W.7 (Sept. 17). A university professor of pathology and a professor of medicine at St. Bartholomew's Hospital Medical College—The Academic Registrar, University of London, S.W.7 (Sept. 18). A professor of anatomy in McGill University, Montreal—The Secretary, Faculty of Medicine (Nov. 1).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Radioactivity induced by Bombardment with Neutrons of Different Energies

FOLLOWING the announcements of Fermi and his collaborators[1] on the radioactivity induced in many substances by bombardment with neutrons, we have undertaken some similar experiments. Using sources containing 50–100 millicuries of radon mixed with finely powdered beryllium, we have been able to confirm in general the results reported by Fermi, in addition to obtaining a few results independently similar to some which have since been, or are now being, published by him.

With the help of Dr. Oliphant, we have also been able to examine the effects induced by the neutrons produced by bombarding various substances with 200–250 kv. diplons[2]. This gives some very interesting information as to the effect of neutrons of different energy. The table given below gives the general trend of our measurements, although the figures are at present only very approximate.

Element bombarded	Period of decay	Source of neutrons			
		Be + Rn	Li + D	Be + D	D + D
Fluorine	8 secs.	100	10	<1	$<\frac{1}{2}$
Silicon	2½ mins.	100	50	<1	<1
Phosphorus	2½ mins.	100	30	<1	<1
Phosphorus	2½ hours	100	50	30	30
Silver	40 secs.	100	10	15	15

Relative rate of production of active atoms by neutrons from different sources (the effect from Be + Rn taken as 100 in each case).

The number of neutrons from each source was estimated using a paraffin-faced ionisation chamber and a linear amplifier of the Wynn-Williams type connected to an oscillograph. The above figures have been calculated so as to correspond to sources giving an equal number of oscillograph deflections definitely greater than the unavoidable background. This is the simplest method of estimating the relative number of neutrons, but may be subject to error when comparing neutrons of different energies.

It will be noticed that in no case was the efficiency of production (for equal numbers of neutrons) as great with the newer sources as with the original Be + Rn source, but nevertheless the behaviour of the Li + D neutrons was not very different. With the other two neutron sources, however, several of the effects do not appear to be excited at all; the case of phosphorus, where the long period is strongly excited while the short period is undetectable, even with a short exposure to the neutrons, being very striking. The neutrons from Be + Rn and Li + D are both believed to be heterogeneous with energies up to nearly fifteen million electron-volts, while the neutrons from D + D are believed to be nearly homogeneous and of energy about two million volts. It would appear from our results that the proportion of high energy neutrons from Be + D must be small, in contrast with the recent results of Livingstone, Henderson and Lawrence, and also of Kurie[3], using three million volt diplons. It is also interesting to note that the reactions which do not appear to occur with the last two kinds of neutrons are those which from general considerations, such as the hardness of the emitted β-rays, would appear to require more energy for their excitation.

We wish to thank Dr. M. L. E. Oliphant for his assistance, and for putting his apparatus at our disposal for these experiments, and Lord Rutherford for his continued interest in our work and for much helpful advice. The experiments are being continued, and fuller details will be published later.

T. BJERGE.
C. H. WESTCOTT.

Cavendish Laboratory,
Cambridge.
July 21.

[1] See, for example, NATURE, **133**, 757, May 19, 1934.
[2] Oliphant, etc., *Roy. Soc. Proc.*, A, **141**, 722; 1933; and A, **144**, 692; 1934. Also Lauritsen, etc., *Phys. Rev.*, **44**, 692; 1933.
[3] *Amer. Phys. Soc. Proc.*, Berkeley Meeting, June 18, 1934, Abstract 12, and private communication to Dr. Oliphant.

Development of the Lightning Discharge

WE should like to give a brief account of some further results obtained with the Boys lightning camera, which has now been modified so as to include a means of determining the order of the component strokes of a discharge.

The material available refers to 55 lightning flashes from eleven different thunderstorms, and the total number of separate strokes photographed is 145. Of these, 65 show clearly the two-fold character which we have previously reported[1,2], namely, a downward-moving leader stroke which at the moment it strikes the ground causes the development of a faster and more intense upward-moving main stroke. If we exclude those strokes photographed under definitely bad conditions (too great a distance, obscured by rain, etc.) the fraction of the strokes showing the leader mechanism is raised from 45 (65/145) to 82 per cent (41/50). Similarly, while 62 per cent (34/55) of the separate flashes show one or more examples of leaders, the fraction is raised to 86 per cent (18/21) if we consider the better photographs only.

The results thus suggest that the leader-main stroke sequence is the most common type of development in the discharge to ground. We have not yet met with more than one or two cases which may be considered significant exceptions. The polarity of the cloud-base in the majority of these flashes is negative, and cases of the reverse polarity are too rare in South Africa for us to have much evidence as to their behaviour. In the case of flashes which do not strike the ground, we do not observe the second or main part of the stroke.

An interesting feature of this new material is that it establishes the general manner in which branches are formed. We find that the downward-moving leader blazes these branches as well as the main trunk of the discharge and that the subsequent main stroke, in its upward course, turns aside to follow the branched leader down such a branch until it catches up with it. We have now 20 cases of downwardly branched leaders, taken from 16 different lightning flashes.

The most important point, however, which emerges from a consideration of these new photographs is that there is a characteristic difference between the leader to the first stroke of a discharge

and the leaders to subsequent discharges along the same track. While the latter are of a continuously-moving, dart-like character followed by fainter luminosity, the first leader is a luminous streamer extending in a discontinuous step-by-step manner from cloud to ground. The length of each step is about 50 metres, and, after completing a step, the streamer luminosity practically disappears for a time of the order of 10^{-4} seconds. After this extinction period, the streamer travels downwards over the old track without developing much light, but as it enters virgin air at the end of the old track it blazes a fresh step very brightly and appears to stop. Since it is difficult to photograph much more than the bright fresh step at the tip of each streamer, the record of this type of leader is usually only a series of elongated dots extending from cloud to ground and separated considerably from one another along the time axis by the camera motion during the extinction period.

This 'stepped' leader is shown on 22 out of the 55 first strokes on our records and is so difficult to see that we consider it must have been present in many other cases. It is shown on 74 per cent (14/19) of our better records. It has not been found associated with any strokes other than the first of a series along the same track. Conversely, no continuous dart-like leaders have been found blazing the way for first strokes.

Owing to numerous pauses in its progress, a stepped leader takes a comparatively long time to reach the ground, sometimes more than one-hundredth of a second, though the velocity of the extending streamer itself is very high. Electromagnetic radiation from such steps would be on a wave-length of approximately 30 km., which is that of the ripple on many atmospherics. The sound waves emitted would have a frequency of about 10,000 and could produce the sound of tearing linen sometimes reported for a close discharge.

We wish to thank the Lightning Research Committee of the South African Institute of Electrical Engineers for permission to publish this letter.

B. F. J. SCHONLAND.
University of Cape Town.
H. COLLENS.
Victoria Falls and Transvaal Power Co.
D. J. MALAN.
University of the Witwatersrand.

[1] NATURE, 132, 407, Sept. 9, 1933.
[2] *Proc. Roy. Soc.*, A, 143, 654; 1934.

Constitution of Carbon, Nickel and Cadmium

DURING recent years considerable controversy has taken place over the atomic weight of carbon, the values obtained by chemical methods and by density determinations ranging from 12·000 to 12·010. At the same time, the abundance of the rare isotope C13 first supposed to be about 1 in 400, has recently been estimated to be as high as 1 per cent.

I have now applied the methods of photometry of mass-spectra to the problem. This could only be done by the use of the comparatively weak second order lines of the element at 6 and 6·5. With alternating exposures of 15 minutes against 5 seconds consistent results were obtained but unfortunately three corrections due to the position of the lines, photographic efficiency and a background effect were all large and rather uncertain. After applying these the most probable ratio of abundance appears to be 140 ± 14. Allowing for the packing fraction of C12 and change of scale we get:

$$\text{Atomic Weight of Carbon} = 12{\cdot}0080 \pm 0{\cdot}0005.$$

The analysis of nickel by means of its carbonyl has been repeated, and the more intense mass-spectra obtained reveal two new isotopes 62 and 61. Lines at 56 and 64 present to less than 1 per cent are probably due to isotopes, but this is not yet certain.

Further work with cadmium has yielded much more intense mass-spectra. These confirm mass-numbers 114, 112, 110, 111, 113, 116 and reveal three new faint ones 106, 108, 115 in this order of intensity.

Svensson[1] has already claimed to have demonstrated the presence of isotopes 118 and 108 by observations on the band spectra of cadmium hydride. The new mass-spectra show that the former cannot be present even to the extent of 0·3 per cent. This discrepancy, and his failure to detect the more abundant isotope 106, suggest that the arguments on which his claim is based are not strictly valid.

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July 21.

[1] NATURE, 131, 28, Jan. 7, 1933.

A General Equation for Induced Polarity

ORGANIC reactions, of which the speed can be affected by the presence of a 'polar' substituent in a molecule, have been classified into two groups[1], for each of which Nathan and Watson[2] have suggested, from analysis of experimental data, an empirical equation to correlate the energy of activation with the dipole moment of the polar substituent. For Class A reactions, accelerated by electron access to the point of attack, they suggest $E = E_0 - C(\mu - \alpha\mu^2)$, and for Class B reactions, accelerated by electron recession from the point of attack, they suggest $E = E_0 + C(\mu + \alpha\mu^2)$.

I have pointed out[3] that the *field* of a dipole operating on any other pole or dipole, whether in the same or any vicinal molecule, will bring about an energy change ΔE varying as $\mu\mu'$ or as μe, and that *induction* of a secondary dipole in a covalent link will bring about an energy change ΔE varying as μ^2.

If the sign of the energy changes enumerated above be considered, it will be seen that the effect of electrostatic induction in a molecule will be to reduce the energy content of the covalent links, since electrons, etc., will tend to move from their unperturbed states to an environment of lower potential energy in the field of the neighbouring dipole. Hence the induction term will always be positive in the activation equation, in which $+E$ represents energy that must be gained before the requisite activation can occur. In contrast, the energy change due to the field of the dipole can be of varying sign, according as the terms $\mu\mu'$ and μe give a positive or negative product. One general equation $E = E_0 + a\mu\mu' + b\mu e + c\mu^2$, in which $a\mu\mu'$ and $b\mu e$ represent vector sums, will therefore fit all cases of induced polarity.

For Class A reactions, $(a\mu\mu' + b\mu e)$ becomes negative; and for Class B reactions it remains positive. Qualitative study of general induced polarity has shown how, in the majority of cases,

the resultant sign of this 'field effect' term can be decided from inspection of a structural formula.

In connexion with a recent note published by Ingold[4], one must point out that the perturbation of the electronic state of a covalent bond by the inductive effect of another pole or dipole should not be regarded as involving any exchange degeneracy of the normal state of the bond. One may suggest that a criterion for the existence of this 'exchange degeneracy' between different parts of a molecule may be that chemical reactivity at one of the points so affected does not proceed at the rate required by the simple activation hypothesis[5].

W. A. WATERS.

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Durham.
June 26.

[1] Ingold and Rothstein, *J. Chem. Soc.*, 1217 ; 1928.
[2] Nathan and Watson, *J. Chem. Soc.*, 1248 ; 1933. NATURE, **133**, 380, March 10, 1934.
[3] Waters, *J. Chem. Soc.*, 1551 ; 1933.
[4] Ingold, NATURE, **133**, 946, June 23, 1934.
[5] Cf. Hinshelwood, *J. Chem. Soc.*, 1360 ; 1933.

Magnetron Oscillations of a New Type

DURING the last year, a new type of magnetron oscillations has been widely used in the Philips' laboratories. These oscillations are obtained by raising the magnetic field above the critical cut-off value in a split anode magnetron. Preferably four anodes are used, which are connected together in opposite pairs, in order to obtain two outside connexions.

It can be shown theoretically that when once a small oscillating potential is set up between the two anodes of an ordinary split-anode type, or between the two pairs of anodes of a four-plate magnetron, electrons can reach the anodes after a spiral path with constant angular velocity (equal to $2\pi f$ in the two-plate magnetron, and equal to πf in the four-plate magnetron), with a linear velocity much smaller than that which corresponds to the D.C. potential of the anodes, so that strong oscillations can be built up. The frequency is determined approximately by the following equation :

$\omega = 2V_a/r_a{}^2H$ for a two-plate magnetron, and
$\omega = 4V_a/r_a{}^2H$ for a four-plate magnetron.
(Note the inverse proportion to H.)

These theoretical formulæ are well confirmed by experiment.

In the case of a four-plate magnetron, the filament or the filaments should preferably be arranged eccentrically to facilitate the starting up of the oscillations. More than four anodes would yield a still higher frequency, but would require more eccentricity of their filaments. Hitherto four anodes have been found to be the most preferable configuration and efficiencies of 50 per cent and more with energies of 50 watts can be easily obtained for a wave-length of 60 cm. With a diameter of 1 cm., strong oscillations of this type are obtained down to 40 cm. (output 30 watts). There is no doubt that decreasing the diameter will yield much smaller wave-lengths, though with less energy.

K. POSTHUMUS.

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June 30.

Atomic Constants deduced from Secondary Cathode Ray Measurements

IN a recent paper[1] published under the above title by Andrews, Irons and me, values of the kinetic energies of secondary cathode rays were tabulated and compared with the values to be expected theoretically (that is, from the Einstein photoelectric equation and the accepted data of X-ray spectroscopy).

Our values of the kinetic energies were deduced from measurements of rH (r=radius of curvature of the path of an electron in a field of H gauss perpendicular to the plane of the path). In order to deduce the kinetic energies from the magnetic deflections, and to express them in a form suitable for comparison with X-ray data, it is necessary to assume values of the fundamental constants e, e/m_0, and h. In the paper we took $e=4\cdot770\times10^{-10}$ E.S.U., $e/m_0=1\cdot759\times10^7$ E.M.U./gm., and $h=6\cdot543\times10^{-27}$ erg. sec. Our energy values came out, on the average, and on the whole very consistently, about 0·5 per cent higher than those deduced from X-ray data. For the latter we took the standard 'crystal' values ; if 'ruled grating' values are used, the discrepancies are still greater.

It is the main purpose of this note to point out that a remeasurement of our instrumental constants has revealed a small, but appreciable, error affecting all the measurements listed in the paper. There appear to have been two sources of error, each less than 1 part in 2,000, but unfortunately both in the same sense, namely : (1) a small error in the setting of the field coils, and (2) an error in the allowance made for an uncompensated component of the permanent magnetic field in the laboratory. The combined effect of these, expressed as a percentage of rH, obviously varies with the field in use, but 1 part in 1,250 (0·08 per cent) may be taken as a satisfactory average value for the fields used in the greater part of the work. Repetitions have been made of typical experiments at different stages of the earlier work, and it seems certain that the experimental conditions and instrumental constants have remained unaltered throughout the whole series.

In the region with which we are dealing, kinetic energy is very nearly proportional to $(rH)^2$, therefore the quoted energies, as determined in our experiments, all require to be reduced by 0·16 per cent. This reduces the discrepancy between 'photoelectric' and 'crystal' values to a little more than 0·3 per cent.

It may also be pointed out that if we take $e=4\cdot768\times10^{-10}$, $h=6\cdot547\times10^{-27}$ (Birge's later values) and $e/m_0=1\cdot757\times10^7$ (a value which is low compared with those accepted until quite recently, but which is now showing definite signs of becoming fashionable), the discrepancy is still further reduced by another 0·22 per cent—that is, to an order of magnitude compatible with quite optimistic estimates of experimental errors.

I have pleasure in thanking Profs. R. T. Birge and A. E. Ruark for their kindness in communicating to me privately some of their results bearing on this work.

H. R. ROBINSON.

East London College.
July 3.

[1] Robinson, Andrews and Irons, *Proc. Roy. Soc.*, A, **143**, 48 ; 1933.

Ratio of the Magnetic Moments of Proton and Diplon

RECENT investigations of Farkas and Sachsse[1] have shown that the ortho $H_2 \rightleftarrows$ para H_2 transformation is catalysed by paramagnetic gases such as oxygen or nitric oxide. This effect is due to the inhomogeneous magnetic field of the oxygen or nitric oxide molecules acting on the magnetic moment of the protons. The fact that a similar process is observed in the case of diplogen shows that the magnetic moment is also in this case different from zero. From the ratio of the reaction velocities in hydrogen and diplogen, A. Farkas, L. Farkas and P. Harteck[2] have calculated, using the theory of Wigner[3], the ratio of the nuclear magnetic moments. They found the magnetic moment of a diplon to be 5·5 times smaller than that of a proton.

In an investigation which will be published shortly, we have considered some details of the theory of this reaction in order to determine with the greatest possible accuracy the ratio of the magnetic moments. Owing to the special interest in the numerical value of the magnetic moment of the diplon, we mention here the main results.

In the paper by A. Farkas, L. Farkas and P. Harteck, the influence of the different mechanical nuclear moments on the transition probabilities was not taken into account. Including this effect in the calculations, one can show that the probabilities of ortho → para and para → ortho transitions are proportional to $\left(\frac{S}{2S+1}\right)\left(\frac{2S+1}{S}\right)^2$ and $\left(\frac{S+1}{2S+1}\right)\left(\frac{2S+1}{S}\right)^2$ respectively, where S is the nuclear spin. Using the values $S = \frac{1}{2}$ for a proton and $S = 1$ for a diplon, we obtain for the ratio of the magnetic moments the value 4 instead of 5·5.

In Wigner's calculations, however, rather special assumptions concerning the spatial distribution of the perturbing forces are involved, so that this new value is also to be regarded as tentative. Therefore, we should like to direct attention to the fact that results of greater reliability can be obtained if the experiments are performed at the absolute temperature T for H_2 and at $T/2$ for D_2. In this case nuclear spins S, magnetic moments μ and reaction velocities k, which are to be compared at the same molar volumes, are connected by the simple relation :

$$\left[\frac{2\mu_D S_P(2S_D+1)}{\mu_P S_D(2S_P+1)}\right]^2 = 2\,\frac{k^{T/2}{}_D}{k^T{}_P}$$

This formula can be derived without assuming any special mechanism of collision, and by neglecting only the minor effects of the intermolecular Van der Waals forces and of the motion of the paramagnetic molecules. Therefore the ratio μ_D/μ_P can be obtained with an accuracy of a few per cent as soon as the reaction velocities $k^T{}_P$ and $k^{T/2}{}_D$ have been measured.

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E. TELLER.
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June 30.

[1] *Sitz. Ber. Preuss. Akad. Wiss. Berlin*, 268; 1933. *Z. phys. Chem.*, B, **23**, 1, 19; 1933.
[2] *Proc. Roy. Soc.*, A, **144**, 481; 1934.
[3] *Z. phys. Chem.*, B, **23**, 28; 1933.

X-Irradiation of Fused Silica

IN experiments which involved the exposure of fused silica to X-rays, it was observed that the fused silica discoloured. The colour was a very dark violet, and disappeared on heating. The silica was of the clearest and most homogeneous optical quality and presumably very pure. We thought it conceivable, therefore, that the coloration might be due to a reduction of silica to silicon and, since silicon is an excellent reflector in the ultra-violet, that the discoloured irradiated surface might reflect better in the ultra-violet than an unirradiated surface.

Part of the surface of a piece of fused silica was, therefore, irradiated for four hours by radiation from a Shearer tube with a silver target carrying five milliamperes at 70 kilovolts. The relative reflection from the irradiated and clear parts was found by illuminating with light from a quartz mercury vapour lamp, and measuring the intensity of the reflected beam by a photocell with a sodium cathode and a quartz window combined with a Wratten filter No. 18a which transmits only over the range 3000–4000 A. The intensity of the beam reflected from the irradiated part was nearly six per cent greater than that from the clear part. Irradiation for a further four hours was carried out, and the irradiated part was then found to reflect above nine per cent more than the clear part. To test whether similar properties appear in the visible, a filament lamp was used as a source and the reflected light was measured with a photronic cell the maximum sensitivity of which was in the region of 0·6μ. It was found that the reflection from the irradiated part was not measurably greater than that from the clear part.

A piece of crystalline quartz was similarly irradiated for a total of eight hours. Only a very slight discoloration occurred in this case, and experiments showed that there was no detectable difference between the reflecting powers of the irradiated and non-irradiated parts of the surface.

It is intended to carry out the measurements on reflection farther into the ultra-violet, including the vacuum region.

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July 11.

Glutathione and Vitamin C in the Crystalline Lens

ESTIMATIONS of the ascorbic acid (vitamin C) content of the crystalline lens, by the indophenol titration method of Tilman, indicate that the crystalline lens contains about 0·26–0·46 milligrams ascorbic acid per gram of lens. Von Euler and Martius[1], Birch and Dann[2], and Müller[3] are of opinion that a considerable amount of the iodine-reducing substances in the crystalline lens, hitherto considered to be glutathione, is actually ascorbic acid.

Because of the importance of these facts in the consideration of the etiology of cataract, I should like to point out three facts obtained by our study of the sulphhydryl system of the crystalline lens—

the data being secured in collaboration with Drs. Hess and Sullivan, of the Chemo-Medical Institute of Research, Georgetown University.

Our data for the glutathione content of the crystalline lenses of cattle, as determined by the Okuda method[4], are in the neighbourhood of 0·330 per cent. Considering that there was no cysteine-containing substance other than glutathione in the sulphosalicylic extracts of the crystalline lens, it was reasoned that acid hydrolysis of an aliquot part should allow us to determine the cysteine liberated from the hydrolysed glutathione. This was actually a fact; the highly specific Sullivan method[5] indicates that fully 91 per cent of the theoretically available cysteine from the titration value for glutathione is accounted for in the hydrolysate. The Sullivan test, when applied directly to the sulphosalicylic extract, is negative, indicating that there is no free cysteine or cystine present in the crystalline lens. The close correlation between the figures for glutathione obtained by direct titration and the cystine values for the hydrolysates indicate to us that the Okuda titration method is fairly accurate for estimating the glutathione content of the *crystalline lens*.

Because of the obvious difficulty in further correlating our data for glutathione with the figures published for the vitamin C content of the lens, I added 2·5, 3·5 and 5·0 gm. of fresh crystalline lens daily to a basal diet lacking vitamin C of each of three groups of guinea-pigs. The experimental animals survived no longer than the controls. This indicates that the crystalline lens contains only small amounts of ascorbic acid and that there is possibly another iodine-reducing substance in the crystalline lens, other than glutathione or ascorbic acid. This likewise appears to be the case in the cancerous tissues examined by Boyland[6] for glutathione and vitamin C.

Our data have led me to these conclusions:

(1) Because of the negative Sullivan reaction of direct extracts, the crystalline lens contains no free cysteine or cystine.

(2) The iodine-reduction titration method of Okuda, when applied to extracts of the crystalline lens, determines fairly accurately the reduced glutathione content.

(3) Although the indophenol reagent indicates that there is considerable amount of ascorbic acid (vitamin C) in the crystalline lens, biological feeding experiments indicate that the addition of 2·5, 3·5 or 5·0 gm. of fresh crystalline lens daily will not support growth of guinea-pigs on a diet lacking vitamin C.

EVERETTE I. EVANS.

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[1] Von Euler and Martius, *Hoppe-Zeylers Z. Physiolog. Chemie*, **222**, 65; 1933.
[2] Birch and Dann, NATURE, **131**, 469, April 1, 1933.
[3] Müller, NATURE, **132**, 280, Aug. 19, 1933.
[4] Okuda, *J. Dept. Agri. Kyushu Imp. Univ.*, **2**, 133; 1929.
[5] Sullivan and Hess, *U.S.P.H.S., Public Health Reports*, Suppl. 86; 1930.
[6] Boyland, *Bioch. J.*, **27**, 802; 1933.

Microchemical Analysis of Plane Polished Surfaces by means of Monochromatic X-Ray Images

THE usual methods of X-ray spectroscopy only permit the chemical analysis of objects of homogeneous composition. In the following note a new method is described which makes possible the examination of surfaces with locally variable chemical composition.

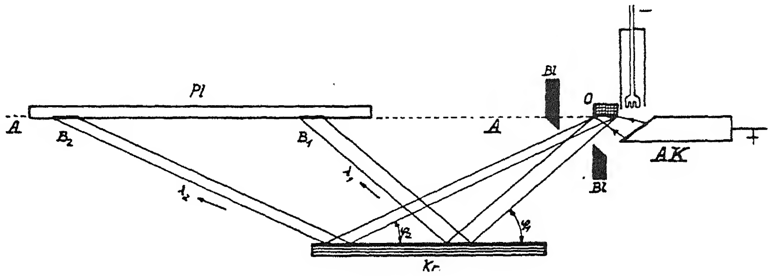

FIG. 1.

The apparatus used is shown diagrammatically in Fig. 1. The surface of the object O to be examined is exposed to the X-ray radiation emerging from the target AK. This primary radiation gives rise to characteristic secondary X-ray radiation the wavelength of which varies with the chemical composition of the surface elements from which it originates. The sodium chloride crystal Kr curved to a cylindrical surface with the axis A–A forms by reflexion[1] a series of monochromatic images corresponding to each secondary wave-length on the photographic plate Pl. Each of these images is due to a definite chemical element, and consequently shows the distribution of this element over the surface to be examined. Fig. 2 shows part of the X-ray image spectrum obtained by this method from the metal

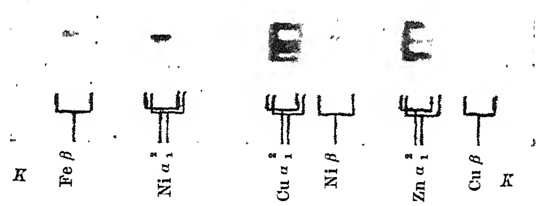

FIG. 2.

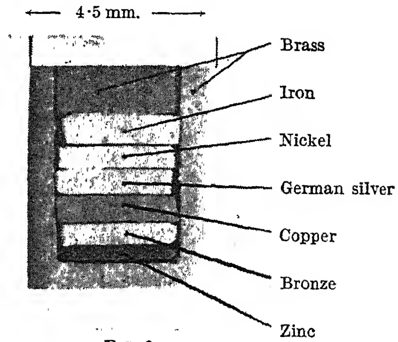

FIG. 3.

surface illustrated in Fig. 3. It may be mentioned that the images formed by the $K\alpha_1$- and $K\alpha_2$-radiations are partly superimposed.

It is expected that the resolving power of the method, which at present lies at about 0·1 mm., can be appreciably increased, and that the use of the method can be extended to elements emitting softer characteristic radiation. Work in this direction is now being done. The method can be applied to investigations on ores and metals and also to follow chemical reactions in the solid state without appreciably changing the object.

L. v. HÁMOS.

Riksmuseets Mineralogiska Avdelning,
Stockholm.
June 23.

[1] L. v. Hámos, *Ann. Phys.*, (5), **17**, 716; 1933. (5), **19**, 252; 1934.

Archæology of the Caucasus

REFERRING to the article with the above title in NATURE of June 16, p. 919, the view of Prof. Fessenden has been extended since. On extracting every place name from the Egyptian mythology (Book of the Dead), I found that all appeared in their relative position in the Caucasus. For example, the capital of Osiris was Akret, the Greek capital of the Caucasus was Ekretike. The blessed fertile land was the valley of Iaru in which were lakes of fire, the fertile mid valley of the Caucasus is the Iora, in which are petroleum springs.

So far, the case seemed strong, but incredible, when this appeared in *Ancient Egypt*, 1926, p. 41. Since then I have found at Gaza the typical ribbed daggers of the Caucasus, and a multitude of the toggle-pins with spiral or ribbed stems, which specially belong to the Caspian slopes of the Caucasus (see *Ancient Gaza*, 2, 16). This material result opens our eyes to six migrations from the Caspian basin to Egypt, which have taken place ranging from the Badarian age to Salah ed Din. Exploration of early sites there is urgently needed, ignoring the late material which has attracted attention hitherto.

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The Membrana Granulosa of the Mouse

THE accompanying figure (Fig. 1) illustrates the membrana granulosa of the developing follicle of the mouse, from a preparation fixed with chromic acid and osmium tetroxide and stained with Mallory's connective tissue stain. As the darkly staining cells shown in particular at *S.C.* are not commonly stressed in descriptions of this tissue[1,2], apparently because their presence is regarded as symptomatic of degeneration, it is desired to direct attention to some of their peculiarities.

They are to be found with great constancy in material from the mouse fixed in this way. They are extremely difficult to see in material fixed in Bouin's fluid or in formol. They are of irregular shape, their nuclei are dense and ovoid, their cytoplasm is darker, both before and after staining, than that of the granulosa cells, and they contain sometimes minute granules of fat and commonly a number of small vacuoles. They are to be found in follicles of every size; in the smallest, one of these cells may reach from the egg to the theca.

Against the view that they are a mark of degeneration may be adduced these considerations: they have every appearance of activity themselves, and they occur in follicles the granulosa cells of which are dividing (see *D.C.* in Fig. 1). That they are recently intrusive elements seems to be negatived by the fact that they occur inside the complete membrana propria (*M.P.*) with no sign of this growing in. From their appearance there seems little doubt that they are the spindle cells mentioned by Deansley[1] in her description of the early stages of the formation of the corpus luteum in this form.

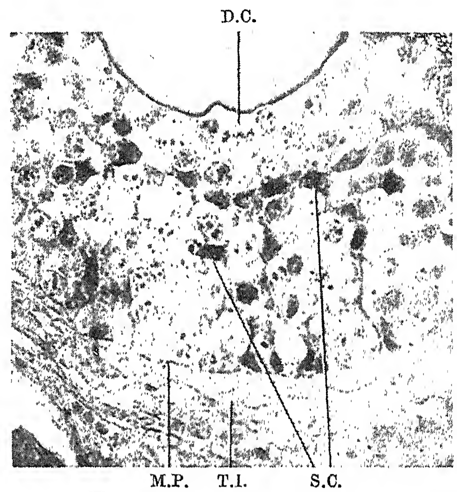

FIG. 1. Membrana granulosa of the mouse. × 500.

They have little in common with the cells of the theca interna (*T.I.*), and it is suggested that they are among the original inner group of cells which is formed round a developing oocyte, and that there are normally two sorts of cells in the membrana granulosa, one of which, the granulosa proper, forms later the luteal cells, while the other forms the reticulum of the corpus luteum. Similar elements are to be found in similarly prepared material from the cat, the guinea-pig, and, to a less extent, the rabbit.

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June 29.

[1] Deansley, *Proc. Roy. Soc.*, B, **107**, 60.
[2] Brambell, "The Development of Sex in Vertebrates". Sidgwick and Jackson. 1930, p. 121.

Causes of Formation of Different Forms of Vertebræ

IN Vertebrata we generally find three forms of vertebræ, namely, procœlous, ophisthocœlous and amphicœlous. In the case of fishes, we get exclusively the amphicœlous form. In birds and mammals the vertebræ approach more nearly to the amphicœlous form than to other types. In the case of Amphibia and Reptilia we get all the three forms in different species, and in the latter class sometimes we get all the three forms even in one individual. The importance of the question is self-evident, as different forms of vertebræ furnish characters diagnostic and useful for classification.

Contrary to the opinion of previous authors[1], I hold the view that different vertebrates follow a general basic principle in the formation of the vertebral centra. After the formation of the notochord and its sheaths, the skeletogenous layer aggregates round them, forming an outer jacket known as the perichordal tube. The intervertebral portion of the perichordal tube remains membraneous or procartilaginous for a long time. Through these intervertebral zones of perichordal tube, the migratory connective tissue cells enter[2-5].

Now the migratory connective tissue cells normally enter through the intervertebral portion of the perichordal tube, the direction being at right angles to the notochord and to the vertebral column. I believe that procœlous, ophisthocœlous and amphicœlous conditions are produced by various types of movement of the embryos at the time when the migratory connective tissue cells are actively entering the intervertebral zones of the perichordal tube.

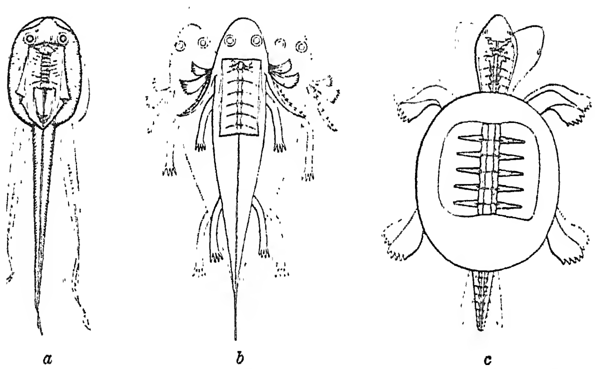

FIG. 1. Diagrammatic figures on which frontal sections passing through the centra of the vertebral column are superimposed. Oscillations of the embryos are shown by dotted lines. The paths of migratory connective tissue cells have been shown by two consecutive lines through the intervertebral zones of the perichordal tube indicated by arrows on both sides.
a, tadpole of *Rana temporaria*.
b, post-embryonic stage of *Triton vulgaris*.
c, post-embryonic stage of *Chrysemys marginata*.

It has been observed that a tadpole moves through the water oscillating the whole body except the head in such a manner that the greatest degree of oscillation will be at the free end of the tail, in both clockwise and anti-clockwise directions, and thereby changing the course of the migratory cells to the notochord, from the perpendicular direction to a curve, the concavity of which is directed towards the cephalic end, and thus leading to the formation of a procœlous condition (Fig. 1*a*).

In the case of newts which were reared in the laboratory, it was observed that during their post-embryonic stage they move forward in the water by oscillation of their head ends and the migratory cells in this case therefore pass in a curve the direction of which is opposite to that of the tadpole; thus an ophisthocœlous condition is produced (Fig. 1*b*). In the eggs of snakes which I examined a rhythmic movement of the embryos is perceptible even from outside the egg-shell, which is rather soft and papery. The vertebræ of snakes are generally procœlous. It may be inferred that the particular mode of movement of the snake embryo is responsible for the formation of this type of vertebra.

So one may conclude that those animals that move their anterior end during the embryonic stage when the migratory connective cells are entering through the intervertebral zones of the perichordal tube have ophisthocœlous, and those that move their posterior end, keeping the anterior end in a so-called stationary condition, generally have procœlous vertebræ. Confirmation of this view is to be found in Chelonia, where the head and neck move in such a way as to present an ophisthocœlous condition, the tail moves in a different direction so as to bring about a procœlous condition, while the middle region of the body, remaining stationary due to the early formation of the carapace, has an amphicœlous condition (Fig. 1*c*).

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University of Calcutta.
May 16.

[1] *Phil. Trans. Roy. Soc.*, B, **187**, 1; 1896.
[2] *Phil. Trans. Roy. Soc.*, B, **218**, 415; 1930.
[3] *Phil. Trans. Roy. Soc.*, B, **219**, 165; 1931.
[4] NATURE, **127**, 705, May 9, 1931.
[5] *Current Science*, 342–343, March 1934.

Enteropneusts in the Clyde Sea-Area

THE following unpublished records from the Clyde sea-area help to extend the summary of the known distribution of British enteropneusts given in NATURE of June 16 by Prof. F. W. R. Brambell and H. A. Cole.

From time to time during the last twenty-five years, parts of enteropneusts, which appeared to be damaged *Dolichoglossus ruber* Tattersall, have been seen in mud dredgings. Undoubted specimens of this species have been dredged off Cumbrae, in December 1927, 20 fathoms, and near Loch Striven Head, in 1929, 7 fathoms.

On several occasions parts of what appears to be a brownish enteropneust, with the peculiar smell of *D. serpentinus*, have been seen in mud dredgings, but no accurately determinable specimens have been taken.

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June 27.

Fossil Insect from the British Coal Measures

IN 1922 I described the wing of a fossil insect with Odonate affinities, from the Upper Coal Measure of Ayrshire, under the name of *Tillyardia*[1]. My attention has been directed to the preoccupation of the name *Tillyardia*[2] in Coleoptera.

I therefore replace the genus name of *Tillyardia* Bolton, 1922, by that of *Truemania* nom. nov., genotype *Tillyardia multiplicata* Bolton, 1922, in recognition of the admirable work done in recent years upon the fauna of the Coal Measures by Prof. A. E. Trueman.

The new name will appear in a list of Odonata shortly to be published by Mr. J. Cowley, of Cambridge.

H. BOLTON.

318, Tilehurst Road,
Reading.
July 11.

[1] "Monog. Foss. Insects of the British Coal Measures", p. 145, pl. x, fig. 2; text-figure 45. Palæontographical Society, 1921–22.
[2] Carter, *Proc. Linn. Soc. New South Wales*, **37**, 489; 1913.

Research Items

Relational Learning in Chimpanzees. Using the multiple-choice method, R. M. Yerkes (*Compar. Psychol. Monographs*, 10, No. 1; 1934) has studied in full detail the efforts of four young chimpanzees to solve a number of relational problems, such as choosing the right hand one of any set of compartments. He found that solution came by sudden discovery of the essential relation in about 50 per cent of the cases, and was fully retained in the control settings. Their ability to apply the correct solution to the control situations is markedly higher than that of other mammals, exclusive of other anthropoids and man, and their behaviour "obviously presages those expressions of human curiosity and originality which we call invention and discovery". The affective condition of the apes is of the greatest importance in relation to success or non-success. There is a general discussion of different types of 'learning'.

Possible Recovery of Trumpeter Swan. Few naturalists in Europe can have realised that during the last few years the magnificent trumpeter swan has been about that lower limit of numbers which generally heralds extinction. Probably the trumpeter swans in Yellowstone Park make up the majority of those now in existence, and of these there were in 1931 only 20 adult birds and 15 cygnets (Science Service, Washington, D.C.). The migrations of the species are limited in extent, and the fact that the Yellowstone individuals do not go beyond the protected area during the winter gives them a greater chance of survival. But even in the Park they have many enemies to contend with—coyote, otter, horned owl, golden and bald eagles—so that in a nest which has been under observation since 1925, not until 1933 did the pair successfully raise young at all. At present, the numbers appear to be at least holding their own; in 1932, there were 58 adults and 12 cygnets, and in 1933, 49 swans and 17 cygnets, against the 1931 total of 35; but until the increase is very much more marked it cannot be said that the trumpeter has escaped the danger of extinction.

Insect Enemies of White Flies in Asia. Mr. C. P. Clausen, of the U.S. Department of Agriculture, has published a paper on the insect enemies of Aleyrodidæ or 'white flies' in tropical Asia (*Philippine J. Sci.*, 53, No. 3, March 1934). During a lengthy tour of the Eastern Orient, the author was able to accumulate a number of observations on this subject. Various species of the host 'white flies' are of economic importance, and a record of their natural enemies is of value in the event of projects, based on biological control, being contemplated. Up to the present, two species noted in tropical Asia have been effectively controlled by parasite introductions, namely, *Aleurocanthus woglumi* in Cuba and tropical America, and *A. spiniferus* in Japan. It is this genus which is perhaps the dominant one in tropical Asia. In number of species and general effectiveness, *Prospaltella* is the dominant genus of parasites in the region concerned and every species of *Aleurocanthus* shows attack by one or more species of *Prospaltella*. Second in importance, the parasite genus *Eretmocerus* requires mention, and, in general behaviour, its various species appear to be well adapted for purposes of attempting biological control. Of hyperparasites, the only species which were reared all belonged to the genus *Ablerus* which attacks indiscriminately all of the primary parasites of *Aleurocanthus*. Of predators, Coccinellid beetles were observed from time to time, but they seldom exercised an influence comparable to that of internal parasites. Larvæ of Drosophilid flies and of lacewings (Chrysopidæ) were also observed as predators, the latter group of insects often being the dominant one in this respect. An occasional predator was also observed in the larva of the Pyralid moth *Cryptoblabes gnidiella*. The paper is accompanied by a list of all the known enemies of Aleyrodidæ in the region concerned.

Pruning of the Tea Plant. In England, the main consideration of the grower in connexion with the practice of pruning has to be its effect upon flower and fruit production, but in the case of the tea plant the aim has usually to be to force a large number of buds into vigorous vegetative growth from which a crop of young leafy shoots may be gathered. Naturally this treatment means a great reduction in the carbohydrate reserves in the plant, and the result is often a very serious 'die-back' of the branch system of the bush. Mr. F. R. Tubbs, plant physiologist of the Tea Research Institute of Ceylon, describes in the annual report of the Institute for the year 1933 the results to date of the trial of a method of cutting back the bushes in which six main outer branches (the 'lungs') are left until about a month before the time of tipping, when they also are cut back to just above a bud. Such vigorous leafy shoots are thus able to contribute to the carbohydrate reserves of the bush before they are removed, and the result has been a considerable increase in the yield of shoots suitable for tipping and a reduction in 'die-back'. This last point is very important, as the withering snags are often places where disease organisms first obtain access. This preliminary report upon the experiments of the Institute is much in favour of the new practice which is termed 'rim lung' pruning. In Great Britain, snag production in the apple has recently been studied from the point of view of anatomy and development by Miss M. E. Wray (*Proc. Leeds Phil. Soc.*, 2, part 12, May 1934).

British Rust Fungi. Mr. W. B. Grove and his colleague, Mr. C. G. C. Chesters, have recently published the results of some investigations on British rust fungi (*Trans. Brit. Mycol. Soc.*, 18, Part 4, 265–275, April 1934: "Notes on British Uredinales, including one new to the British Isles"). *Uromyces sparsus*, the new British species, has been found on plants of sea spurrey (*Spergularia marina*), uredospores, teleutospores and æcidia being now known. *U. scirpi* produces teleutosori on *Scirpus maritimus* and æcidia on *Oenanthe crocata* (water dropwort), *Glaux maritima* (sea milk-wort) and possibly other plants. *U. acetosi*, *U. striatus*, *Puccinia Luzulæ-maximæ*, *P. cirsii-lanceolati*, *Melampsora euphorbiæ-dulcis* and *M. symphyti* are also described. The account is a useful addition to Mr. Grove's book, "British Rust Fungi", bringing several of the descriptions up to date.

Translocation of Nitrogen. Further information regarding the transport of nitrogenous materials in the cotton plant is given by T. G. Mason and E. Phillis

in No. 6 of the *Memoirs of the Cotton Research Station, Trinidad* (reprinted from *Ann. Bot.*, **58**, 315–333; 1934). Curtailment of nitrogen supply to the roots of the plant in the vegetative condition limits the growth of the apical region, and the young tissues absorb nitrogen at the expense of the mature leaves lower down. The stem tissues continue to gain nitrogen from the mature leaves, and the normal negative gradient in the stem persists, even during pronounced nitrogen deficiency in the apical tissues. As the plant passes from the vegetative to the reproductive condition the developing bolls withdraw nitrogen from the bark, which results eventually in reversal of the negative gradient. This suggests a gradient of storage, rather than structural nitrogen. Concentrations in the bark depend apparently on the age of the tissue, a greater proportion of storage nitrogen being found in the older lower parts than in the younger upper ones. Variation of the nitrogen supply to the roots, from conditions of deficiency to excess, produces no significant change in the direction of the bark gradients, which remain negative throughout. It is concluded that nitrogen continues to be stored in the bark even in conditions of nitrogen starvation. The non-withdrawal of calcium from the vegetative parts of the plant during bolling confirms the suggestion previously made that calcium is not normally mobile in the phloem. The facts seem to support the view that nitrogen travels by a diffusion process in the sieve tubes down a gradient of mobile nitrogen, but against a gradient of organic storage nitrogen.

The Cambrian of Shropshire. The Cambrian rocks of the neighbourhood of Rushton, Shropshire, described by Drs. E. S. Cobbold and R. W. Pocock (*Phil. Trans. Roy. Soc.*, B, **223**, 305; 1934) occupy a wedge-shaped area between the Wrekin fault on the east and the Church Stretton fault on the west. Structurally, the area consists of the broken core of an anticline in Charlton Hill, pitching southward, and the broken syncline of Rushton, also pitching southward. Lower, Middle and Upper Cambrian deposits are represented, and correspond closely with those of the well-known Comley area situated about 12 miles to the south-east, and almost all the faunal horizons found at Comley are represented at Rushton. A correlation table (pl. 39) shows the relation of the faunal horizons of Shropshire to those in the Cambrian deposits of other parts of the world. The main part of the paper, by Dr. Cobbold, deals with the palæontology of the deposits, with descriptions of several new species; the groups represented are Annelids, Brachiopods, Hyolithids, Trilobites, Conchostraca, with one Gasteropod and possibly a Polyzoon.

Annual Perturbation in the Range of Tide. R. H. Cockran (*Proc. Roy. Soc.*, A, May) discusses an annual perturbation in the range of tide, obtained originally from observations at Liverpool but apparently existing all over the world and consistent from year to year. The method of analysis consists in comparing the semi-diurnal component of the observed tides calculated by Doodson's method with the semi-diurnal component of the 'synthesised tide' obtained from the harmonic constituents. The existence of the perturbation was further studied by independent analysis of hourly heights and of high and low waters. The cause of the perturbation is not established. In polar waters, the change of boundary conditions due to ice may account for an annual perturbation; in narrow channels, the perturbation may arise from the superposition of an annual variation in the non-tidal current. These explanations are inadequate for the open ocean.

The Inter-electrode Capacitance of Valves. The introduction of the screen-grid valve has considerably increased the stability of the radio-frequency amplifier and the level of possible amplification. This improvement is attributable to the minuteness of the coupling between the input and output stages containing screen-grid valves, and is associated with the small value of grid-to-anode capacitance in such valves. Previous methods of measuring this small capacitance have required special apparatus and in particular a micrometer condenser. These limitations have been avoided in two methods developed at the National Physical Laboratory, and described recently by Mr. T. I. Jones in a paper entitled "The Measurement of the Grid-Anode Capacitance of Screen-Grid Valves" (*J. Inst. Elec. Eng.*, June). In the first method, the working value of the capacitance is deduced from measurements of the change in the input capacitance of the valve upon reducing the anode load from a known value to zero. It is necessary to know the amplification factor of the stage, and this is measured independently. The second method measures the grid-anode capacitance with the filament cold. The result is obtained in terms of the ratio of the readings of two voltmeters and the settings of a variable air condenser covering a range of capacitance over which it can be calibrated directly. Full details of the two methods and the results of typical measurements are given in the paper.

Dipole Moments of Substituted Mesitylenes. Some measurements of the dipole moments of halogen and nitro-substituted mesitylenes (F. Brown, J. M. A. de Bruyne and P. Gross, *J. Amer. Chem. Soc.*, June) are of interest in connexion with the theory of mutual interactions by induction of the substituent groups in a molecule proposed by Smallwood and Herzfeld in 1930 and tested in other cases. In mesitylene the inherent moments due to the three methyl groups symmetrically placed in the ring cancel one another, and the results thus allow of a study of the interactions between the methyl groups and the other substituents which is reasonably free from complication. The moments of the F, Cl, Br, I and NO_2 compounds are 1·36, 1·55, 1·52, 1·42 and 3·65, all in benzene (the last being 3·63 in CCl_4). The calculated values are 1·42, 1·60, 1·58, 1·43 and 3·99, in good agreement except in the case of the compound containing the nitro-group, which also shows anomalies in other compounds. The agreement in the case of the iodine compound is particularly interesting, since the iodine atom, with its large size and deformability, might be expected to be considerably affected by the close proximity of two methyl groups in ortho-positions.

The Imperial Standard Yard. In the paragraph on page 147 of NATURE of July 28, on the Imperial Standard Yard, the following words should have been added at the end, "in air at 62° F.", as the conditions for which Dr. Tutton's number of Cd_r wave-lengths in the yard, 1,420,209·8, was obtained. Messrs. Sears and Barrell give for air at 15° and 20° C. the numbers 1,420,210·81 and 1,420,204·02. They do not give the number for the official temperature 62° F. (16·66° C.), but by interpolation it would be 1,420,208·6, which is only 1·2 wave-lengths different from Dr. Tutton's value.

South-Eastern Union of Scientific Societies

Annual Congress at Reading

THE Annual Congress of the South-Eastern Union of Scientific Societies was held at Reading on July 11–14, under the presidency of Prof. H. L. Hawkins. By the courtesy of the Vice-Chancellor and Council and Senate of the University, the meetings were held in the various buildings of the University, the grounds of which were thrown open for the use of those attending. The president's address was entitled "Fossils and Men", and was in part a philosophical discourse on the lessons to be learnt from over-specialism in both ancient and modern life, and the invariable consequences resulting from such specialism, notably as regards human life. The address was a notable one. "To some the voice of Evolution is a birthday serenade, to others it is the tolling of the passing bell," was a passage which one might quote. "The Lords of Creation of one era are the fossils of the next," is another. "If numbers imply success, graptolites and ammonites were successful groups. We can scarcely guess what inborn impetus drives some groups to riotous evolution, leaving others almost static; but we can find an analogy in human temperament, where the mercurial and the stolid may appear for no apparent reason in the offspring of one marriage. Persistent stocks are not the actual ancestral types, but are the simplest derivatives from those types that possess all-round efficiency. *Cidaris* was not, by a long way, the first sea-urchin to appear; there were plenty of queer experiments in the echinoid world during the palæozoic eras; but it is, and since triassic times has been content to remain, the simplest expression of orthodox sea-urchinity. *Nautilus* came into being after a long succession of preliminary types had come and gone; it has proved more durable than scores of its less and more elaborate relatives.

"The efficiency of short-range types is that of the specialist, who is supreme in his own particular line and a hopeless fool in any other. The danger of undue specialisation is almost self-evident. An expert in the use of the crossbow would not find much scope in a modern naval battle; while a professor of Hellenistic Greek might starve on a desert island where an agricultural labourer could scrape an adequate living. The moral emerges that a specialized type is efficient only in special circumstances, and becomes like a fish out of water when circumstances change. A Jack of all Trades may not excel in any; but he is less likely to find himself stranded than the master of a single trade that goes out of fashion. In other words, to become thoroughly efficient in one respect is to be relatively incapable in others. This is, in effect, a restatement of the principle that simple, moderately efficient types last longer than those that are highly specialized.

"In the education of the young we must point to the pitiable failures of man the successful animal, and the glorious achievements of man the struggling soul.

"There is no precedent by which we can foretell the issue of the triumph of reason; but a million witnesses await us in the rocks and catacombs to testify to the outcome of uncontrolled specialization. Reason, and reasoned ideals, give outstanding qualities to individuals—'An honest man's the noblest work of God'. Surely it does not seem a hopeless experiment to try the effect of humanity for men, and to leave bestiality to beasts.

"And so the lesson of Palæontology is the same that has been taught by seers, sages and saints down the ages. They used their human faculty of imagination to find the truth; and few there were that heard it. But fossils are a sign for this generation; their evidence is open for all who care to see it. We must strive to avoid somehow the fate that has always overwhelmed animals like us. Looking around in despair, we find that only idealism is free from the taint of death. Pure thought and noble ideals alone can raise mankind out of its present mortal danger to a position where success, even if it cannot be commanded, may at least be deserved."

The ancient charters of Reading, which were on exhibition at the Museum, were explained by Mr. W. A. Smallcombe, the curator. Much interest was shown in the reproduction of the famous Bayeux 'tapestry' which is one of the chief features of the Museum, and in the Roman treasures from Calleva (Silchester). The extensive ruins of old Reading Abbey were visited, on one wall of which is a large reproduction of the canon, "Sumer is icumen in", one of the earliest musical compositions of the country, said to have been composed by a Reading monk.

In the Zoological Section, Dr. C. B. Williams, of Rothamsted, gave an address on "Insect Immigration in Great Britain", summarising the information to date, and incidentally mentioning that the present year has not been a good one from the immigration point of view. In 1933, eighty reports were received of actual movements to and across the country.

Major H. C. Gunton outlined a scheme by which amateurs in local societies can assist in the recording of the earliest and latest observations of fifty well-known insects, to which, it was stated, considerable importance is attached by the Entomological Department at Rothamsted. Mr. Smallcombe gave details of the "Local Vertebrate Fauna during the Human Period". In the absence of cave-deposits in the district, the gravels yielded evidence of such animals as reindeer, red deer, bison, woolly rhinoceros, hippopotamus, lion, sabre-toothed tiger, hyæna, mammoth, and a lower jaw of Irish elk, the latter giving rise to some discussion. At the Kennet mouth, on the site of the gasworks, an Early Iron Age settlement revealed amongst other mammals the beaver.

Mr. F. H. Edmunds read a paper on "The Water Supply and Geology of the South-East of England", and gave instances of the long galleries, sometimes a mile or more long, which have been driven in the chalk in order to intersect drainage channels and fissures. The Eastbourne well at Friston is 110 ft. deep but has a heading 4,012 ft. long. The normal water-table under London is potentially above the level of the chalk surface, but cannot rise through the impermeable tertiaries above it. Chalk water is, in effect, under constant pressure against the overlying beds, and, when bored into, the water overflows as artesian water. The water-table under London has, however, sunk considerably into the chalk of late years. At Slough a boring was put down in 1909, reaching the Lower Greensand at 1,021 ft.

from the surface. The pressure was so great against the overlying strata that the water in rising blew a hole in the factory roof, and flowed at the rate of 100,000 gallons an hour. Water under similar pressure was found at Virginia Water, where it rose 90 ft. above the ground. Instances were given where the flow of water was in the first place very great, but owing to the silting-up of the bore-holes with fine sand and clay the supply rapidly fell off.

Prof. E. B. Poulton gave a lecture on "The Power of Changing Colour as a Form of Protective Resemblance", and an address was given by Sir Lawrence Chubb to the Regional Survey Section on "The Rights of Way Act, 1932".

The excursions were of considerable value. Silchester was visited, and the Botanical Section explored Greenham Common and the Kennet Valley. The valuable farms of the University at Shinfield, Sutton's Seed Trial Grounds, and Huntley and Palmer's factory were also visited. Prof. Hawkins led the geologists to Kingsclere, and to Theale and Pangbourne, in the latter showing how the Kennet water is to a great extent conveyed by underground channels to the Sulham stream and so to the Thames at Pangbourne, instead of following the main Kennet River to Reading, whilst the Pang itself is now almost dry. The final excursion was a long one to the Vale of White Horse, passing on the way the dolmen known as Wayland Smith's Forge, and Uffington camp, afterwards reaching Uffington by way of the neck and body of the so-called White Horse, which, however, may be the hen-headed dragon of the Celts, said to have been slain by St. George on the flat-topped hill isolated below.

A Quantitative Study of Trance Personalities

It is well known that the Society for Psychical Research has for many years studied the variations of personality observed in the mediumistic trance. This has generally been done by means of historico-legal methods, that is, by estimating the evidential value of the statements made by the personalities alleged to be communicating through the medium under observation. This procedure is a perfectly valid one, and it would be entitled to full experimental status if a more reliable method than any used hitherto of computing the value of such free material could be devised. Nevertheless, it is obviously desirable that these trance personalities should be investigated by normal quantitative methods, and to this problem the Society for Psychical Research has now turned its attention.

Mr. Whately Carington (formerly Whately Smith) has attempted to apply to trance personalities the well-known technique of the word association test and the psychogalvanic reflex. A list of words is read out to the subject, who is supposed to react to each stimulus word with the first word that enters his consciousness; his response is recorded, together with the time taken by him in answering and the change in the electrical resistance of the subject's skin resulting from the 'excitement' produced in him by the stimulus word. There is good experimental reason for believing that the magnitude of this change (measured with a Wheatstone bridge and galvanometer) is a fair measure of such excitement. When the standard list of 100 words has been gone through in this way, it is rapidly read over a second time to test the subject's accuracy in reproducing his responses, failure to do so being regarded as an indication that an inhibitory complex is present. The whole process is gone through several (usually six) times to obtain a reliable mean, and the resulting data are regarded as characteristic of the subject's personality.

Such is the technique in general, on which Mr. Carington is an acknowledged authority, and which he has now attempted to apply to the problems of psychical research. If tests were to be applied to a medium in his normal state and then to a trance personality manifesting through the same medium's body, with his normal consciousness in abeyance, a comparison of the two series of data would clearly yield information as to the degree of likeness or unlikeness between the two personalities. Thus, Mr. Carington argues, definite evidence would be obtained regarding the status of the trance personality.

In his present report (*Proc. Soc. Psych. Res.*, 42, 173–240, July 1934) Mr. Carington sets out the results of a first experiment on these lines, carried out with the mediums Mrs. Garrett, Rudi Schneider and Mrs. Leonard. Unfortunately, in each of these cases the circumstances were such that a full investigation was impossible. Mrs. Garrett turned out to be a very difficult subject for psychogalvanic reflexes, the electrical resistance of her skin being erratic to such a degree that the resulting material was inadequate for the application of Prof. R. A. Fisher's analysis of variance. In the case of Rudi Schneider, the subject did not fully co-operate, so that the results cannot be taken at their face value. In the case of Mrs. Leonard it was not possible to test the psychogalvanic reflex at all, the experiment being limited to reaction times and the reproduction test. From the fragmentary data obtained with these subjects, Mr. Carington concludes that in the case of Mrs. Garrett she and her 'control' Uvani are significantly different; that Schneider and his 'control' Olga are significantly similar; and that in the case of Mrs. Leonard, her 'control' Feda, and two other of her trance personalities, significant differences exist.

It will be asked of *what* these differences are held to be significant. On this point Mr. Carington expresses himself with due caution, but it is clearly his opinion that if Mrs. Garrett's and Mrs. Leonard's 'controls' were merely split-off secondary personalities, they would not have shown the differences they actually yielded. Unreserved acceptance of this conclusion would, however, be premature, for next to no information is available as to the amount of similarity or difference these tests would yield if actually applied to a pathological case of secondary personality, to a subject in hypnosis, or even to an actor playing a part. Moreover, the results seem far too dependent on the goodwill and free co-operation of the subject. Mr. Carington has undoubtedly made a valuable and thoroughly scientific contribution to psychical research, of a kind warmly to be welcomed, but a series of control experiments is essential before his results justify any generalisation with paranormal implications.

U.S. Bureau of Standards

THE annual report of the U.S. Bureau of Standards for the year ended June 30, 1933, is very satisfactory, notwithstanding the industrial depression. New determinations of the values of the electrical units have been made by absolute measurements. In the case of the ohm, the inaccuracy was only of the order of about one in a million. The Bureau has fixed the visibility factors for commercial types of electric lamps by means of coloured filters. These values have been adopted internationally. A piezo-electric standard has been constructed which maintains a wave frequency constant within one part in ten million for several hours without adjustment. The accuracy of the 5,000 kilocycle radio transmissions which are disseminated periodically has been increased to one in ten million.

At the request of the Bureau of Fisheries, an investigation was made into the methods of gauging the mesh size of gill nets. The problem has a direct bearing on the conservation of fish particularly in the Great Lakes, where fishing is controlled by the bordering States and by the Dominion of Canada. A flexible standardised steel gauge has been found to give the accuracy required.

Another research was in connexion with doubtfully authentic documents and other objects. This work covers a very varied field. Seventy-seven identification tests were made, and on fifty-eight of these definite reports were given which enabled the Government to proceed with or discontinue the investigation. On the others, definite decisions by the Bureau were impossible owing to insufficient material or the difficulty in discovering satisfactory characteristics.

Research on commercial X-ray machines has revealed that the effective voltage applied to an X-ray tube and the effective current through it are far better indicators of the quality and quantity of the X-rays emitted than the peak voltage and average current commonly specified. This has led to developments which will promote greater safety to hospital workers and probably lead in turn to lower insurance rates.

The temperature coefficients of the rigidity modulus and of Young's modulus for thirty-four samples of various metals and alloys have been determined. A knowledge of these coefficients is of great value in aeronautics. During the year, there was great popular interest in the reduction of noise. More than fifty different samples of sound-absorbing materials were tested for the public, and numerous samples of materials for use in Government buildings. The usefulness of the spark test for carbon and alloy steels was studied by testing 280 materials. The results proved that for sorting mixtures of steels of known composition, this test is by far the best.

The old methods of testing textile cloths by 'handle' and 'feel' will soon be obsolete. Two new instruments have been developed for this purpose. A more accurate method of testing for the presence of acid in leather, which often causes rapid deterioration, has been devised. Commercial standards have been agreed to after consultation with the many industries concerned.

Three encyclopædic volumes of specifications have been published and two more are in active preparation. This report will prove of value to everyone interested in the progress of industry.

Autoxidation of Mineral Oils and Lubricating Value

AT a meeting of the Institution of Petroleum Technologists on January 9, Mr. R. O. King demonstrated the present point of view regarding blending of mineral oils. As a rule, mineral oils are blended for use under conditions where a complete fluid film is to be maintained. Thus separation of the lubricated surfaces, friction, and the prevention of wear are dependent upon certain physical factors, for example, viscosity of the oil, relative motion of the surfaces and mechanical design.

Under conditions, however, where the oil film is reduced to molecular dimensions, friction and wear are largely dependent upon an intangible property known as 'oiliness'. Recent investigations have contributed towards definition and promotion of this property. Experiments with unloaded, relatively thick oil films subjected to high rate of shear have shown that this particular property of lubrication depends upon the presence in the oil of certain active molecules or upon their formation as products of oxidation even at low temperatures.

More recent experiments with loaded oil films, under conditions conducive to great oxidation activity, have proved that high-temperature lubrication is dependent essentially on that activity and only indirectly on viscosity. Apparently, under conditions where extreme pressure and temperature are involved, blending cannot be successfully accomplished without regard for oxidation properties of the constituents. Autoxidation is initiated through chemically active compounds being formed from direct attachment of a molecule of oxygen to an oil molecule; hence to obtain optimum lubricating value at relatively low temperatures, one of the constituents should be capable of easy oxidation.

Results of experiments made with both single varieties and blended oils at high temperatures show that with unblended fluid improvement of lubricating value is slight and relatively short lived, while viscosity increases with oxidation at higher temperatures for a short period only and then decreases. With blended oils, however, viscosity increases under similar conditions and remains at the higher value over relatively long periods of oxidation. The difference in behaviour of the two types of oil can definitely be ascribed to autoxidation in the blended variety.

The conclusions are that blended mineral oils are better lubricants than single varieties having the same physical properties and that the successful blending of mineral oils for optimum performances in oxidising conditions, must depend upon the selection of constituents capable of maintaining the necessary oxidation activity over a specified temperature range.

University and Educational Intelligence

CAMBRIDGE.—The E. G. Fearnsides scholarship, for the encouragement of clinical research among the organic diseases of the nervous system, valued at £100, has been awarded to J. B. Harman, of St. John's College.

MR. V. K. RANGA V. RAO, of Gonville and Caius College, Cambridge, has been awarded the Garton Foundation studentship in social sciences for 1934. The studentship was founded by the late Sir Richard Garton to help students in the universities of the British Empire to devote themselves to the study of social or economic problems.

THE following scholarships, valued at £100 or more, have been awarded by the Institution of Electrical Engineers for 1934: Ferranti scholarship, F. C. Williams; Duddell scholarship, S. I. Hollingworth; Silvanus Thompson scholarship, S. G. Bittles; Swan Memorial scholarship, E. Bradshaw; David Hughes scholarship, W. B. Hutchison.

ROBERT BLAIR fellowships, tenable during the session 1934–35, have been awarded to Mr. P. D. Holder, of Cranford Nailsea, near Bristol, who proposes to carry out an investigation in the United States of America of the design and erection of steel-frame buildings; and to Mr. David M. Tombs, of London, who proposes to carry out a study and research with Prof. Zenneck, at the Munich Technical High School, into methods of short-wave propagation and reception.

THE University of Leeds' annual report for 1932–33 sounds a note of optimism. Towards the second half of the session, signs of a revival of industry gave ground for the assurance that the worst of the financial anxieties of the Council were over. The student enrolment was approximately the same as in the preceding year, notwithstanding the important restrictions imposed by the Board of Education on the number of students in the training departments of universities—restrictions which are expected to result in a reduction in the number of such students at Leeds from 425 in 1931 to 325 in 1935. Substantial progress was made towards the completion of the great building scheme. It is anticipated that the Brotherton library may be finished by 1935. Other important developments were: the institution of new faculties of law and economics and commerce; the incorporation in the University of the work of the Leeds School of Pharmacy, providing courses leading to the qualifications of pharmaceutical chemist and chemist and druggist; modification of the ordinance for general honours in science so as to require candidates to offer two instead of three principal subjects; the launching, in co-operation with the Royal Bath Hospital, Harrogate, of a scheme for the investigation of chronic rheumatism and allied conditions; and a project for a part-time course in biology leading to a diploma, designed to meet the needs of teachers in schools. In answer to an appeal from the Academic Assistance Council on behalf of expatriated German men of science and scholars (mainly of Jewish origin) the University agreed to accept not more than three for a period of two years as 'special research students'.

Science News a Century Ago

Measuring Electricity

It is important to remember that no method of measuring electricity existed in 1831, when Faraday entered upon the great period of his electrical researches. The galvanometer, the outcome of Schweigger's invention of the 'multiplier' in 1820, was not yet the indispensable instrument it afterwards became; it was not until 1833, in a footnote to his Third Series of Experimental Researches, that Faraday referred to "the great and general value of the galvanometer as an actual measure of the electricity passing through it". The relation between the three quantities we now call current, electromotive force and resistance, upon which modern methods of measuring the electricity in a circuit depend, had been established by G. S. Ohm in 1827; but his work was neglected at first. His paper, "Die Galvanische Kette", was mathematical, and written in German, circumstances which explain why Faraday apparently had no knowledge of it.

Faraday's conceptions involved the distinction between 'quantity' and 'intensity' which was common at the time, depending largely on the observed differences in the behaviour of electricity from the voltaic battery and from the frictional machine. He wrote in his Diary on August 5, 1834: "Quantity in Electricity appears to be analagous to the pitch in sound or the colour in light, and intensity in electricity to the loudness of the sound or the vividness of the light, i.e. to associate with increased energy of vibration but not with more numerous vibrations".

His own measuring instrument was the 'volta-electrometer' or voltameter. It was based, characteristically, on an experimental principle, that of the chemical action of the electric current, and was described by him in 1834 as "the only actual measurer of voltaic electricity which we at present possess".

Death of J. M. Jacquard (1752-1834)

On August 7, 1834, Joseph Marie Jacquard, the French inventor, died at the village of Oullins, near Lyons, at the age of eighty-two years. Though he made several inventions, the one he will always be remembered by is the Jacquard loom for weaving figured fabrics, an invention which for the first time enabled a weaver working single-handed to produce patterned materials according to a given design. This was a step forward of immense importance to Jacquard's native city of Lyons, where, a few years after his death, a monument to him was erected. The Jacquard loom, brought to a successful issue in 1804–5, was the result of a combination of several devices rather than a single invention, and is an example of the cumulative effect of mechanical progress.

Jacquard was born at Lyons on July 7, 1752. The son of a weaver, he received no schooling and at twelve years of age began work in a bookbinder's. From the bookbinder's, he went to a typefounder's, then to a cutler's and on the death of his mother joined his father as a weaver. Evidently gifted with mechanical skill far above the average, he was always endeavouring to improve on the tools of his trade. During the Revolution he was an ardent soldier, and at the opening of the nineteenth century a new chapter of his life began. A medal from the Industrial Exhibition of 1801 was followed by

the grant of a patent. In 1802 he invented a machine for making fishing nets and about the same time was given a post at the Conservatoire des Arts et Métiers, where among the models he found the loom of Vaucanson. Back again in Lyons, and encouraged by some of the manufacturers, he was able to develop his loom, and in 1806 Napoleon authorised the municipality of Lyons to purchase the invention. Jacquard was given a pension of 3,000 francs and the latter part of his life was passed in comparative ease. A man of simple habits, modest and dignified, he retired to the village of Oullins and it is there he is buried. His original loom is preserved in the Conservatoire des Arts et Métiers beside that of Vaucanson.

Zinc Sheathing for Ships

Several times, zinc has been tried for the sheathing of ships with the object of preventing fouling, and on August 9, 1834, under the heading "Mosselmans Zinc", the *Mechanics Magazine* said: "Mills for the rolling of this valuable metal have been erected at Dartford and commenced working on Saturday last. The event was celebrated by a *fête champêtre* which was attended by a number of the most distinguished merchants and shipowners of the city of London, several eminent engineers, men of science, etc. Mr. Ward, late member for London, in proposing the health of Mr. C. P. Chapman, the manager of the establishment, spoke in high terms of the service Mr. C. had rendered to the country by the introduction of so cheap and efficient a substitute for copper in the sheathing of ships, at a time when economy of expenditure is an object of such vital importance to the shipping interest. The demand for zinc for this purpose is, we understand, increasing with astonishing rapidity, and hence the importance of having rolling mills so near the metropolis, where sheets of any thickness or size can be turned out as fast as wanted. The machinery of the mills has been constructed by Messrs. Hall, the eminent engineers of Dartford, and is of a very complete, though necessarily simple, description."

Howard's Quicksilver Boiler

Among the inventions experimented with in the early days of steam navigation was the mercury boiler of Thomas Howard in which the heat of the furnace was communicated to a shallow closed pan containing mercury, on the upper surface of which a small stream of water was sprayed through a nozzle. The apparatus was fitted directly underneath the engine cylinder, and the steam evaporated by contact with the upper surface of the mercury vessel was passed into a casing around the cylinder, and then through ports into the cylinder. A fan was used for the draught for the furnace, and the steam leaving the cylinder was condensed in a copper vessel immersed in a cistern of water continually supplied from the sea. This arrangement was tried in H.M.S. *Comet*, 232 tons, in 1834, and on August 10 a correspondent described the apparatus in a letter to the Editor of the *Mechanics Magazine*. It was said that whereas the *Comet* used with the ordinary low-pressure flue boiler $6\frac{3}{4}$ cwt. of coal per hour, with Howard's boiler the consumption would only be $3\frac{1}{2}$ cwt. The quicksilver boiler was afterwards fitted in the paddle vessel *Columbus*, of 325 tons, but an explosion led to its abandonment.

Societies and Academies

Dublin

Royal Irish Academy, June 11. W. B. MORTON: The stability and oscillations of certain permanent arrangements of parallel vortices. The arrangements in question are those which formed the subject of an earlier paper, namely, any three vortices at the corners of an equilateral triangle and four, with a definite ratio of strengths, at the corners of a rhombus. The slightly disturbed motions are discussed, and the frequencies and modes of oscillation about the steady motions are determined. It is found that the triangular arrangement is stable when the centre of the vortices lies within the circle circumscribing the triangle and the rhombus when its acute angle exceeds a critical value, arc cos $(1/\sqrt{3})$.

Paris

Academy of Sciences, June 11 (*C.R.*, **198**, 2033–2128). ELIE CARTAN: The tensorial calculus in projective geometry. H. DESLANDRES: A simple and general relation of the molecular spectrum with the electrons and rings of electrons of the constituent atoms. A discussion of a new formula with special reference to the infra-red frequencies of sodium chloride, nitric oxide and methane. L. CAYEUX: The difficulties of classification of the old limestone sediments. L. BLARINGHEM: Heredity in mosaic of *Geranium pratense*. JEAN LOUIS FAURE was elected a member of the Section of Medicine and Surgery in the place of the late P. Bazy. NIKOLA OBRECHKOFF: Univalent polynomials. I. POPA: Centro-affine geometry of skew curves. MAURICE FRÉCHET: The importance, in applications, of the nuclei to which the theory of Fredholm does not apply. G. VRANCEANU: The geometrisation of the systems of Pfaff. MIROSLAW KRZYZANSKI: Generalised absolutely continuous functions of two variables. STEFAN KEMPISTY: The totalisation of functions of two variables. E. REMES: On a convergent method of successive approximations for determining polynomials of approximation. GEORGES VALIRON: The singularities of holomorph functions in a circle. O. YADOFF: The regulation of the power of hydraulic turbines having to work under variable heads. JEAN VILLEY: The permanent flow, in two dimensions, of a very rapid current of air round a cyclindrical obstacle. P. SWINGS and B. EDLÉN: The presence of the forbidden lines of argon IV in the spectrum of nebulæ. HENRI MARCELET: The capillary index of some vegetable oils. RENÉ LUCAS: A new type of powerful electromagnet for the study of double refraction and of atomic jets. The electromagnet described gives a field of 20,000 Gauss with an ordinary laboratory battery (120 volts, 4·4 amperes, or 530 watts). J. L. DELSAL: The polarimetric study of beryllium tartrates. There exists in solution only one beryllium tartaric complex, $H_2C_4O_6(OH)_2Be_3$, which is formed whatever may be the proportions of the reagents. ANDRÉ CHARRIOU and MLLE. S. VALETTE: The influence of antioxygen bodies on the sensibility of photographic emulsions. The lowering of the sensibility of a photographic emulsion by the incorporation of an antioxygen body confirms the view that these substances are, in a general manner, de-activating substances for molecules excited by radiations. V. DOLEJŠEK and A. NĚMEJCOVÁ: The photographic inversion due to the simultaneous action of two different radiations. MME. ROY-POCHON: Photoelectric cells of the

boundary type. Cells possessing the same sensibility to light may be very different in rectifying power. Selenium cells with rectifying power practically zero have a very small temperature coefficient and the relation between current and illumination is nearly linear. E. VELLINGER and R. DELION: The superficial properties of certain colouring matters. The experimental results are given as a curve showing the relation between the interfacial tension of a solution of bromothymol blue and paraffin oil as function of the *p*H of the aqueous solution. FRANCIS PERRIN: The dissymmetry of the positive and negative β spectra and the intrinsic mass of the neutrino or ergon. On the hypothesis of an intrinsic mass zero for the ergon, it is possible to explain mathematically the dissymmetry of the β^+ and β^- spectra. MME. IRÈNE CURIE, F. JOLIOT and P. PREISWERK: The radio-elements created by the bombardments of neutrons. A new type of radioactivity. A. MICHEL-LÉVY and H. MURAOUR: Experiments in micropyrotechny. The luminous effects accompanying detonation are not independent of the nature of the gas which surrounds the explosive. The effect of varying the gas surrounding the explosive (lead azide) is marked: two photographs are reproduced showing the light effects in argon and carbon dioxide. MARCEL GUILLOT: The iridescence of antique glass. The formation of Liesegang strata in the glass, in contact with solutions of bicarbonates, by the rhythmic precipitation of calcium carbonate. In the case of a periodic precipitation of the type of Liesegang rings, the glass behaves similarly to gelatine or other gels. ALBERT ROUX: Rapid tests for the determination of electrochemical corrosion of welded joints. JEAN SWYNGEDAUW: The action of the electric current on the fields of diffusion in colloidal gels. A. TRAVERS and YU KWONG CHU: Dimetaphosphoric acid. Description of a method of preparation of pure crystallised sodium metaphosphate, $Na_2P_2O_6, 3H_2O$. P. VIÈLES: The spontaneous resolution of racemic dilactyldiamide in aqueous solution. HENRI WAHL. The nitration of chloro-*p*-xylene. RAYMOND QUELET: The preparation of 2-methoxy-5-bromo-α-chlortoluene and its action on organomagnesium compounds. GEORGES CORROY: The Oligocene under the molassic basin of Malaucène (Vaucluse) according to a recent boring. Summary of the results given by a boring to a depth of 402 metres. MLLE. F. FLOUS: An abnormal case of vascular evolution. CHADEFAUD: The morphological signification of the physodes of the Phœophyceæ. H. COLIN and MLLE. A. CHAUDUN: The composition of intercellular cement. MICHEL FLANZY: The presence of methyl alcohol in the foliar organs of plants. The relation between this alcohol and the chlorophyll pigment. Methyl alcohol was present in all the six plants studied, thus confirming the work of Maquenne. There was a marked parallelism between the variation of the methyl alcohol and production of chlorophyll. Green leaves are richer in methyl alcohol than etiolated leaves. MME. LUCIE RANDOIN and ROGER NETTER: The possibility of realising, in the absence of all known lipo-soluble vitamins, a food equilibrium permitting the growth and maintenance of the rat. J. VELLARD: Variations of the reactions of spider venoms. The acidity or alkalinity of spider venom depends on the temperature. In Brazil, venom of the same species is nearly always acid in winter, but in summer alkaline reactions predominate. The alkaline venoms are generally more toxic than acid venoms. ANDRÉ BOIVIN, MME. LYDIA MESROBEANU and ION MESROBEANU: The toxic and immunising properties of a substance isolated from the Aertrycke bacillus. R. ARGAUD and A. MOUGEOT: Neurogenic reactions of the isolated ventricle of *Helix pomata*: their anatomical substratum.

CRACOW

Polish Academy of Sciences and Letters, April 9. T. NAYDER: The density of liquid iodine. The author has determined the density of liquid iodine by a hydrostatic method between the temperatures 114° C. and 184° C. K. DZIEWONSKI and J. MAYER: Syntheses of compounds derived from 2-phenylquinoline. MME. K. KRAINSKA: Studies on the development of *Eupagurus prideauxi*. Segmentation and gastrulation. S. HILLER: Contribution to the knowledge of the intimate structure of the hypophysis of the horse. THAD, VETULANI and ROBERT SCHULZE. The hypophysis of the small Polish horse representing the steppe tarpan type, especially that of the silvan tarpan (4).

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 1, No. 9). N. CHETAJEV: A theorem on instability. A generalisation of the theorem of Liapunoff on the instability of movement and of the reciprocal of the Lagrange theorem. A. V. MITKEVICH: Some conditions increasing the phenomenon of magnetic viscosity. The conditions unfavourable for the intensified rearrangement of elementary magnets during the time of the change of magnetic force increase the subsequent manifestation of magnetic viscosity. When studying magnetic viscosity, it is quite indispensable to take into consideration the previous magnetic history of the metal. D. IWANENKO: Two remarks on the theory of β-radioactivity. I. STARIK and M. DEISENROT-MYSOVSKAJA: A criticism of the photographic method as applied to the investigation of the colloidal state of polonium. The method may produce incorrect results owing to the adsorption of radio-elements and should not be used in studies on the colloidal state of radioactive elements, but it can be of great value in studying adsorption phenomena. M. ROMANOVA and A. FERCHMIN: The hyperfine structure of the green krypton line 5570. The same ten components were observed by the authors as by Kopferman and Wieth-Knudsen (*Z. Phys.*, **85**, 353), except that instead of − 0·0053 A., a component − 0·0130 A. was found, and an eleventh component + 0·003 A. was observed. G. KRUTKOW: A proof of the theorems of statistical mechanics on the unification and the separation of two systems. S. GVOZDOVER and F. KONOVALOV: The action of a stream of slow electrons on a mercury arc. M. P. VOLAROVITCH and D. M. TOLSTOI: Studies on the influence of the temperature and of the electrolytes on the plastic properties of kaolin. M. VOLAROVITCH: Contribution to the study of the viscosity of molten rocks. Andesite proved to have the highest viscosity while it is progressively smaller in techenite, diabase and basalt. K. M. GORBUNOVA and Z. ADZHEMJAN: Electrocrystallisation of metals (4). Electrolytic sediments of aluminium from the molten salts of ($AlCl_3$ − NaCl). The optimum composition of the electrolyte is to be found apparently in the equimolecular mixture of sodium and aluminium chlorides. V. I. NIKOLAEV and S. A. GLINSKIKH: Calcium oxychloride, $3Ca(OH)_2 . CaCl_2 . 11H_2O$. V. S. SADIKOV and E. V. LINDKVIST-RYSAKOVA: The behaviour of diamino acids of protein hydrolysates

towards permutit. E. ASRATJAN: The effect of a simultaneous cutting of both jugular sympathetic nerves upon food conditioned reflexes in dogs. The changes in the higher nervous activity of the dog after the first extirpation of the upper jugular sympathetic ganglia are due chiefly not to the extirpation itself, but to the interruption on the transmission of central impulses. N. UDOLSKAJA: Drought resistance of spring wheat varieties. The relative drought resistance of a variety is a variable quantity depending on the combination of external factors constituting the 'drought', on the growth conditions preceding the drought, and on the stage of growth. This accounts for the 'loss of drought resistance' on transferring a variety to another region. A. I. POTAPOV: New colorimetric methods for the determination of the toxic aluminium in the soil. A normal development of plants under sub-tropical conditions is often hampered by an excess of aluminium ions. Extracts from the fruit of *Rhamnus* and from the petals of *Tagetes* proved to exhibit very sensitive colour reactions suitable for the detection of very small amounts of aluminium in the soil. D. KOSTOV: Crossing-over in the species hybrids of *Nicotiana*. The crossing-over occurs between the maternal and the paternal chromosomes in the species hybrids.

ROME

Royal National Academy of the Lincei, Feb. 4. G. A. MAGGI: Additions to the note on reflexion and refraction of harmonic electromagnetic waves of any form at a plane surface. L. PETRI: The cause of *court-noué* of the vine according to Viala and Marsais. Various criticisms are advanced against the results obtained by Viala and Marsais. L. SOBRERO: Theorems of the theory of hypercomplex functions (2). G. GHERARDELLI: Systems of doubly linear plane curves. D. GRAFFI: The eccentricity of the orbit in the problem of two bodies of variable mass. L. GIALANELLA: New determination of the latitude of the Royal Campidoglio Observatory, and determination of the instrumental constants of the 'Bamberg' meridian. L. SONA: The problem of the reflexion and refraction of electromagnetic harmonic waves. R. ZAÏCOFF: Generalised wave mechanics (2). F. PIRRONE: Investigations in the field of high frequency. Biochemical action of ultra-short electromagnetic waves (2). Although feebler and variable, the action of Lakhovsky oscillating circuits is analogous to that of radio apparatus capable of emitting waves of $\lambda = 1{\cdot}7$ metre. For a constant time the action of such waves is proportional to their intensity and is favourable to the life of simple organisms for continuous exposures of 10–40 minutes or discontinuous exposures up to 90 minutes. As the exposure is prolonged, the favourable effect on cell multiplication diminishes. M. AIROLDI: New investigations on the crystalline mass of Calizzano-Bardineto (Ligurian Alps). I. DELPINO: Meiotic divisions in *Telphusa fluviatilis* Latr. A. MESSERI: 'Intercalar' differentiation in radicular and hypocotylary bundles of conifer plantlets. V. ZAGAMI: Content of the *E* factor in leguminous seeds. Vitamin *E* is present in seeds of *Cicer arietinum* L., *Ervum lens* L., and *Vicia Faba* L. in sufficient quantities to ensure uninterrupted reproductive capacity in rats, provided that mineral salts and vitamins A and D are also supplied. Seeds of *Lathyrus sativus* L. also contains this vitamin, but to a lower extent.

Official Publications Received

GREAT BRITAIN AND IRELAND

Public Health Congress. Report of the Committee on Hospital Equipment, 1934. Pp. 47. (London: Public Health Congress Council.)

Proceedings of the Royal Society of Edinburgh, Session 1933–1934. Vol. 54, Part 1, No. 8: The Atomic Weight of the Calcium contained in very Old Potassium-rich Minerals occurring at Portsoy, Banffshire, and at Cape Wrath, Sutherlandshire. By William W. Smith and Thomas Tait. Pp. 88–101. 1*s.* 3*d.* Vol. 54, Part 2, No. 9: The Photo-electric Thresholds of some Turned Metallic Surfaces. By J. S. Hunter. Pp. 102–108. 9*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

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Synthetic Study of Man

TO the contemplative mind any considerable gathering of men of science drawn from a variety of countries affords ample food for thought; but when that gathering is composed of anthropologists, as was the International Congress of Anthropological and Ethnological Sciences which met in London on July 30–August 4, there seems to be a peculiar propriety in its international character. It affords a working model, as it were, of the process of coming to an understanding of an alien point of view and mode of thought, which, we are told, it is one of the aims of certain branches of anthropological studies and their application in practical affairs to attain. If the good-fellowship, which was such a conspicuous feature in this anthropological congress, affords any criterion, either the discipline is eminently successful in attaining this one of its objects, or the anthropologist is exceptionally fortunate in temperament. For it must be recorded that this first meeting of the newly constituted Congress was, from every point of view, scientific or social, one of the most successful of the scientific congresses that have been held in London in recent years. To have gathered together for a week's discussion more than a thousand members drawn from forty-two countries—so far afield as Japan, China and South America, from every corner of Europe, as well as from the remotest parts of the Empire—was in itself no small achievement.

H.R.H. Prince George, who received the delegates, in declaring the Congress open, pointed out that a reunion of this kind has three main purposes. The members had come there, he said, "to review recent advances in knowledge . . . to compare your experiences and ideas; and to add something to our notions of what man is and what man does". He went on to say: "Above all, you are here to make the acquaintance of one another and to gain that knowledge of the personal equation which means so much in scientific work." Who will say that in this last remark His Royal Highness did not put his finger on the vital point which justifies, in the long run, the expenditure of time, money and labour entailed by the organisation of a congress on such a scale?

No man of science, it may be, but would endorse fully the value of the personal equation. It undoubtedly assists in the appreciation of the mode of approach in an attack on the larger problems of science, especially in those in which methods

of exact measurement are not directly applicable; but it is rather in the intimate realisation of a common aim and a common pursuit of scientific truth that personal contact attains its fullest fruition. It assures that broad conception of science as an end in itself, to be pursued without regard to political opinion or national bias. It is, in fact, in the intimacy of those personal relations that warmth and colour are given to the recognition of the international standing of scientific inquiry and research, and it is one of the means whereby the aspiration that science should transcend national boundaries issues in practical effect.

In one respect the international congress enjoys an advantage—of a somewhat meretricious character, perhaps—over other gatherings for scientific discussion. In the somewhat capricious working of the dissemination of scientific news, it has a readier access to the public ear through the popular Press. It was no doubt with this at the back of his mind that Sir Grafton Elliot Smith, in his incisive opening remarks as president of the Section of Anatomy, put the case for the international congress admirably on both general and specific grounds, when he pointed out how the discussion of scientific problems for which it affords opportunity should serve to dissipate the misconceptions which are utilised to bolster up political propaganda. He went on to point to the specific instance which is now in the minds of all, the deliberate misuse in Germany of the term 'Aryan' in a racial sense, and its further distortion to the sense of 'non-Jewish'.

Time is demanded to weigh and digest the vast mass of material presented to the members of the Congress; and it would be premature to attempt any estimate of how far anthropological studies have been advanced by the proceedings. At the same time, it cannot be doubted that the discussions, such as that on the blood-groups, to which we refer elsewhere in this issue (p. 222), by defining terms or by isolating problems upon which further research must concentrate as a condition precedent to further advance, have helped to clarify ideas and in so far constitute a very real progress.

In one respect, however, it is possible to say emphatically that the Congress has served its purpose. Had it gone no further than the issue of its programme, it might without too great exaggeration be said to have advanced research materially. By their organisation of the proceedings into sections for the presentation of communications, the promoters of this first meeting have laid down lines which define the scope of the science, and have propounded views of the interrelation of the various departments of the somewhat amorphous study of man. For while it is generally conceded that the science of anthropology is concerned with all that man is as well as all that man does, in practice opinions differ widely both as to whether that definition is to be taken as all-inclusive in regard to subjects, and also as to how far and at what point, as for example in the investigation of social institutions, a special discipline, in this instance say sociology or economics, is to take over from the more generalised study.

The list of sections will be found *in extenso* on p. 222. It will be seen that four sections form a biological series in which problems of man's phylogeny and taxonomy, distribution and the mental qualities by which he is specifically *Homo sapiens*, are considered. Three sections are devoted to the description of peoples according to geographical distribution. Finally a group of four sections together covers man's relation with the material world and his methods of exploiting it—technology—man's relations with his fellow-men—sociology—and man's relations with beings of the other world—religions. The last section of this group deals with man's method of communicating with his fellow-men and with spirits—the section of language and writing.

By a wise convention, communications were not expected to range at large over the whole field, but were, if possible, it was suggested, to confine themselves to certain stated problems in each division of the subject. The organisers hoped in this manner to concentrate attention on the more urgent problems of the moment. Thus, in the Section of Anatomy among the topics put forward for discussion were the blood-groups as a criterion of race, certainly one of the most insistent subjects of debate in racial questions at the moment, and man's place among the primates. As a result, a well-directed consideration of the problem in each case ensued.

In these days specialisation is a necessary evil; but it is an evil that can be mitigated. It would, for example, have been welcome had a broader treatment of genetic questions in relation to the problem of race been possible. As it was, the eugenic issue alone was raised. It may well be that the synthetic view of the study of man, which emerges from the scaffolding erected by the

organisers of the Congress, will continue to affect the future orientation of investigation and may help to correct the over-emphasis which has been laid of recent years on certain aspects of cultural research.

It is another view of this same trend which would direct attention to the overweighting of anthropological study in the direction of primitive or 'savage' peoples. This is no new plaint. It has been pointed out frequently that man is still man although he may be civilised. The arguments about race, which are now being thrown out recklessly in certain quarters, show how little real understanding there is of the racial problem among European peoples—a fact, indeed, to which attention was directed by a resolution of the Section of Anatomy, pressing for intensive study of the question. When workers in the field were few it was the wise, and indeed the obvious, course to concentrate on primitive peoples who were dying out or changing rapidly; but in the interests of the general principles of the science, anthropologists can no longer afford to neglect the universal for the particular. Man must be studied as one, whole and undivided, as well as in part.

Now that the practical application of the results of scientific research enter largely into almost every feature of daily life, it is becoming increasingly apparent that, whereas formerly practical utility was a secondary consideration, and more often than not a by-product, of pure research pursued for its own ends, nowadays practical considerations vitalise scientific studies. This is not the whole story; but it holds good in anthropology (if not yet to the same degree), as, for example, in chemistry or biology. Just as the study of genetics has been and will continue to be essential to the agriculturist and breeder, so the study of race and of culture will be of paramount moment in the government and in the direction of the future development of man. Unfortunately, while this is, or should be, an article of faith with every anthropologist, it has not yet secured complete and general recognition.

This, however, is the lesson to be drawn from the wise remarks made by Lord Onslow in his presidential address to the Congress, when he contrasted the efforts of the nineteenth century to Europeanise backward peoples, with the teaching of anthropology to-day that the future development of such peoples must be built on the foundation of their own institutions. How far anthropology will be enabled to assist in this task will, however, depend, as has already been said, upon its ability to formulate general principles and apply them to cases. That this exercise in casuistry, in the better sense, is not beyond exponents of the science is suggested by such communications as those submitted to the Congress by Prof. Arnold J. Toynbee and Dr. R. R. Marett, to make a selection which is in no sense invidious. Thus the Congress serves to point a moral, if a congress may be said to have a moral, that anthropology must see its problem whole; and, in that whole, practice, as well as theory, has a part.

The Agony of Knowledge

The Birth of the Future. By Ritchie Calder. Pp. xiv+298+9 plates. (London: Arthur Barker, Ltd., 1934.) 10*s.* 6*d.* net.

Mr. Ritchie Calder, in this work, tells us of a pilgrimage he has undertaken "into those strange places where the world of the future is being born—the scientific laboratories of to-day". We wonder! At least, we doubt the "being *born*". To some of us, it seems more likely that our world is very old and maybe running down: science, indeed, is seemingly but a new ribbon road leading us to still faster destruction, with new buildings arising on either side which more and more obscure natural beauty: in large measure, it is a 'wash-out': scarcely anywhere can an economic crop be grown without fertilisers; few have yet considered what the political consequences of this state may be.

I recently had the opportunity of visiting the noted caves at Altamira, a taxi-drive out of Santander, Spain. We there saw the remarkably finished, almost life-sized drawings of animals, in black and red ochre, set out upon the nearly horizontal roof of the cave. The anthropologists aver that these are at least twenty thousand years old. The cave, to-day, is lit up electrically; we are not aware by what light the artist worked and what opportunities the cave-dwellers had of seeing his efforts illuminated. What was so striking at Altamira, to a visitor like myself, was the grim contrast between art and electricity: the one so old, the other so new—scarce a century old: in fact, its use has been developed under my own eyes. During the interval, since the cave drawings were made, art probably has made little advance and art feeling too; both are everywhere more or less decadent and untrue to-day,

displaced by the machine: yet the whole world is under the control of electricity, although this only began its travels abroad in 1866, the year in which the first successful Atlantic cable was laid by the *Great Eastern*—a ship I saw upon the stocks. Whilst developing and worshipping the machine, man is doing little to develop himself: he remains very like the Altamiran artist. In fact, he is giving no scientific thought to his own upbringing. This, popular writers are beginning to point out, none too soon:

"If we were one-half so clever in the matters that lie far outside machinery as we are about machinery itself, what people we should be and what a world we should leave our children. I have no doubt that boys and girls in Coventry are comparatively well looked after but nobody has attended to them as their fathers are attending to the proud young *Double-Six-Daimlers*."

So writes Mr. J. B. Priestley in his "English Journey", in giving an account of his visit to the highly organised motor-car works at Coventry. The comparison is one that should put schoolmasters and education authorities to shame. The conscious care lavished upon the machine has no counterpart in the treatment of the up-growing child!

Mr. Priestley raises an equally important social issue in describing his experience at Lincoln. After visiting the cathedral at the top of the hill, where scientific thought has no place, he goes to an engineering works below where he sees a giant *steam digger* in course of construction. Eventually, directed by a single man and fed only with petroleum, this will do the work of 800 navvies. Charity may be preached upon the hill-top; no thought of practising it prevails at the bottom. Men are fast being made unnecessary: we shall soon need only a man or two here and there—machines will do the rest; society will be like the big fish to be seen at the British Museum (Natural History), with a small male grown to her side. Where is such 'progress' to stop? Great is the engineer, but can we allow him to prevail exclusively, the slave of commerce and industry?

In various countries, millions upon millions are being held in almost helpless subjection by a few dictators: because of the engineer, who has furnished them with the machine-gun. In last resort, this commands the world to-day.

The League of Nations has done little else but keep the sore of military war alive: the root causes of international difference are in no way considered. A small island nation, without command of machinery sixty years ago, is now at commercial war with all other countries—and succeeding—largely with the aid of machinery we have supplied. All the world to-day is in seething discontent, owing to the lop-sided development of mechanical enterprise and our failure to raise the general level of human intelligence—to use our knowledge except to commercial ends. It is easy to chortle in our joy over present scientific achievement, but what of the future?

Think of the unconscious work done, after the father has placed his order, by the mother in fashioning the child—work of infinite complexity, of infinitely greater delicacy and difficulty than any that is involved in any machine that is consciously made by human hands. Once born, however, apart from the perfunctory brute affection she lavishes upon her offspring, the intellectual care she takes of the child is little more than intuitive and superficial. She has little, if any, technical training for her office and is without knowledge both of her own and of her child's mechanism. The father is even more ignorant and considers that his duty is done when he sends his child to school, without thought of consequence: there training is given for the forum but not for the market-place.

The 'Double-Six-Daimler' would soon be on the scrap-heap, if treated as is the human child. Yet we are excited because deaths from motor accidents on roads occur at the rate of about 180 per week. Though we are beginning to complain of the garages in which human beings are being lodged, there is no public conscience as to their general treatment, mental, moral or physical: millions lead maimed lives in consequence. Man may be a tool-using animal—he shows this by the marvellous way in which he flies—but he is nothing more: he has no developed thought for his own immediate interests, for either his body or his soul. No scientific effort is made by the schooling class to fashion those who are its slaves during the impressionable years of life.

The writing on the wall is there, if we will but see it—in the Crystal Palace, the Great Exhibition of 1851, fathered by Prince Albert. Appropriately made of glass, it stands to-day a transparent monument of failure: its iron ribs, made of puddled steel, wonderfully resist decay—as do ours; still, unless acid, water and air can always be kept from them, they are doomed to perish—their life depends upon the protection of paint the

owners can afford to give. In 1851, we were all but at the peak of our commercial industrial prosperity—only the introduction of steel, especially in shipbuilding, delayed the rapid fall of the curve. We had arrogantly supplied the whole world and ignorantly thought—if we thought at all—that we could continue to live at the expense of the outer world: to-day, the outer world will scarcely look at us; moreover, what is true of ourselves is true of every other industrial nation: each has a similar surplus. We all have to reconsider our modes of living and learn, if possible, to live together. Unless we apply to the ribs of society the paint of rational training, nothing can prevent their rusting away.

The social shoe pinches in not a few other directions. With all our boasted scientific progress we have only begun to think with intelligence about our food during little more than the past twenty years. The public generally take little interest in the subject—far less than formerly. In her recent interesting book of reminiscences, "A Backward Glance", Mrs. Wharton, a well-known American author, at the close of an interesting account of her home life, in which she speaks most highly of the devoted and skilful service rendered by mulatto cooks, writes as follows:

"I have lingered over these details because they formed a part—a most important and honorable part—of that ancient curriculum of housekeeping which, at least in Anglo-Saxon countries, was so soon to be swept aside by the monstrous regiment of the emancipated: young women taught by their elders to despise the kitchen and the linen room and to substitute the art of acquiring University degrees for the more complex art of civilised living.

"The movement began when I was young and now that I am old and have watched it and noted its results, I mourn more than ever the extinction of the household arts. Cold storage, deplorable as it is, has done far less harm to the home than the Higher Education."

Perhaps the new Wine and Food Society will do something to stem the debacle. The fear is, that the modern development of flat life and motor-scurrying may lead to harmful modes of feeding; the prospect is all the more serious now that we are told by statisticians that forty or so years hence we shall have a population of 33 millions, not as Carlyle said, 'mostly fools', but mostly old women. The consequences of misfeeding women have not been taken into account: if not fatal, they may influence unpleasantly the general outlook of those old ladies. We cannot safely allow anything and everything, drugs in particular, to be advertised into use: the legitimate use of advertisement is a subject we greatly need to consider.

As to cold storage and higher education, which Mrs. Wharton feelingly links together, the gift of the former, looked at from any other than the commercial side, is probably a doubtful blessing: even commercially, it has two aspects, as it favours foreign competition. What is saved on the roundabouts of supply may be is lost on the swings of quality. When we know what is food, we shall be able to discuss the issue scientifically. The argument applies equally to food preservation by canning. That dog 'Science' has a strange way of going mad to serve commercial ends and spitefully biting where it should bless.

The "Higher Education" to which Mrs. Wharton refers is another subject calling for scientific treatment. This has been undertaken from the beginning in a wrong spirit—in a spirit of rivalry. Women have mostly sought to show that they can do what men do, not to improve their power of doing woman's work. Fortunately, of late, there has been a tendency on the part of the leaders to recognise that the pendulum has swung too far away from the woman: unfortunately, we have allowed the debasing influences of Hollywood to poison the female mind, and the Church has long failed to exercise any moral control. This failure also we shall need to study scientifically, in shaping the future of our world. The nation is in danger of being entirely misled by the Department of Scientific and Industrial Research, which is shaping inquiry all but entirely along commercial lines. Research in natural science can take care of itself: what we really need to foster is inquiry into the application of scientific method to the moral and social development of the masses. The girls are everywhere turning out the boys, whilst neglecting their own work. At least, we shall be forced to train the boys to girls' work—which will be a modern development of the *Couvade*. Society cannot allow boys to become hooligans, through lack of work and idleness. We know already that kitchen work might be better done by them: at least, with more circumspection. If feeding ourselves properly and so giving ourselves healthy, happy lives be the future chief task of society, as it will be, domestic service will be the highest form of social service: chemists will be trained in the universities to be real cooks, for service, not merely to play about with *Deuthydrogen* and

electrons. Some use must be found for intelligence : the kitchen makes most demand. Men are too intelligent only to operate machinery—women ask to be made parts of a machine. The chemist alone can grasp the influence of structure upon function and understand that mentalities must differ. 'Beilstein' is an embodiment of our human nature : only those who understand 'Beilstein' will grasp the complexities of human nature.

As yet we have put no scientific thought into our affairs. In a terminal essay on "The Practice of Diplomacy", at the close of his remarkable work on "Lord Curzon", Mr. Harold Nicholson writes in a way to show that this is becoming clear even to statesmen :

"The present impotence of individual statesmen is not solely due to the rise of democracy but must also be ascribed to the greater complexity, the increased interdependence, of the factors which they endeavour to mould. Mussolini is no less unfettered than was Cavour ; Hitler is even more unhampered than was Bismarck. Yet their capacity for creative action is limited by the fact that no modern problem can possibly be self-contained. Human affairs are no longer manageable by a single individual will, nor can they be comprehended as a whole by any single human intelligence. They have outgrown the capacity of any individual brain. Statesmanship henceforward will have to be a corporate and not a one-man business."

The Germans long ago recognised and applied this doctrine : hence their great industrial success before the War. The Japanese are also making use of scientific method in their affairs. Here, no systematic account is taken of knowledge and experience. Hazlitt long ago discoursed on the "Ignorance of the Learned". Probably, no class to-day is so ignorant as the teaching class : so thoughtless ; so unmethodical ; so blind to the changes in society brought about by the application of the art of scientific inquiry. Lord Fisher's advice was sound : either we scrap the lot or we perish, not from lack of knowledge but from failure to use it. Bows and arrows are the present armoury of the schools : we have to change these for long-range weapons.

If the class of labour employed in making machinery had been as uninventive, as insufficiently trained and as unskilled as is the great mass of that engaged in fashioning the human machine, there would have been little flying and few high speed records of any kind.

Mr. Ritchie Calder's book is the work of a super-enthusiast, who has persuaded himself into believing that he has a mission. Unfortunately it is written in the snappy, sensational style favoured by a section of the Press to-day : it is not literature, in any proper sense of the term. Such an account necessarily lacks feeling and is uncritical. The spirit behind the work of scientific inquiry cannot be brought to the fore by such writing : the book therefore does not help the young idea to shoot. Nonetheless, it will be full of interesting matter to many. The good points are well brought out in a foreword by Sir F. G. Hopkins, the president of the Royal Society, who dwells especially upon Mr. Calder's expressed conviction that no cure will come for the illogical state of our world until the methods of scientific thought are introduced into the conduct of public affairs.

Sir Gowland Hopkins makes the all-important statement that it is his "personal belief that scientific opinion should be organised in this country and so organised that when it is expressed upon matters within its competence, it should be with such authority that no government or legislative House could ignore it". Far more is needed : the introduction of the spirit of scientific method and the spirit of scientific inquiry into all public affairs. I imagine these are practically unknown in the commercial world : this could not otherwise be so entirely averse from all use of standards of value and given over to speculation as it is.

It is in Sir Gowland Hopkins's power to effect his projected organisation almost by a stroke of the pen—by organising the fellows of his Society into a consultative body. These physicians must learn to heal themselves, in the first instance : they must study the method they themselves use, often unconsciously. They must co-operate in bringing the nation under the rule of scientific method. This may involve a bitter struggle against our human nature.

No other course will suffice. The Society itself may need some modification, in order that it may have the necessary width of outlook. To this, no objection can be taken. It no longer serves any necessary, useful purpose as a Society for the publication of the results of scientific inquiry. Unfortunately, since the War, it has largely abrogated the functions it formerly exercised as a consultative body, the body scientific to-day having lost most of its public spirit, being overcome by speculation and the blind worship of so-called research : without regard for educational efficiency.

HENRY E. ARMSTRONG.

Applied Spectroscopy

(1) *Spectroscopy in Science and Industry: an Introductory Manual describing its Applications to Industrial and other Practical Problems.* By Dr. S. Judd Lewis. (Blackie's "Technique" Series.) Pp. vii+94+10 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1933.) 3*s.* 6*d.* net.

(2) *Metallurgical Analysis by the Spectrograph: being some Experiences of the Application of the Spectrograph to the Analysis of Non-Ferrous Metals and Alloys.* By D. M. Smith. Pp. xi+114+10 plates. (London: British Non-Ferrous Metals Research Association, 1933.) 10*s.* 6*d.*

(3) *Optische Messungen des Chemikers und des Mediziners.* Von Dr. Fritz Löwe. (Technische Fortschrittsberichte, herausgegeben von Prof. Dr. B. Rassow, Band 6.) Pp. xii+205+4 plates. (Dresden und Leipzig: Theodor Steinkopff, 1933.) 9 gold marks.

(1) THERE must have been little thought of industrial application of the first important spectroscopic investigations more than two hundred and fifty years ago. To-day there can be few industries of any importance that fail to make use of the spectroscopic method in the control of products, whether they be metals, foodstuffs or medicines.

Dr. Judd Lewis's book differs from the other two under review in that it devotes rather more space to elementary principles. Besides giving the reader a very good idea of the meaning of spectra and the various instruments used for analysis, the methods of detecting impurities in different samples are set out very clearly. In addition to the discussion of the internal-standard method and the ratio-quantitative method, one would have liked to see a little more about the *raies ultimes* method originated by de Gramont. The chapter on industrial and scientific applications of emission-spectrum analysis is followed by others on spectrophotometry, absorption spectroscopy; and very brief mention is made of Laby's method of using the X-ray emission spectra: the work of Hevesy along the same lines is not mentioned. The inclusion of ten plates of spectrum photographs adds to the value of this little book, which should be of use to all physicists and chemists who require a good straightforward introduction to applied spectroscopy. H. G. J. Moseley's name on page 88 is misspelled.

(2) Mr. D. M. Smith's monograph stands in a rather different category. The outlook is narrower, but the treatment is much more complete. Mr. Smith is largely concerned with the analysis of non-ferrous metals and their alloys. After introductory chapters on general principles, the spectrum and its photography, qualitative analysis and technique, we are given a discussion of the various methods of quantitative analysis. The internal-standard method originated by Gerlach is well explained, and the various photometric methods for the quantitative estimates of line intensities are given. Valuable sets of tables, accompanied by well-reproduced plates, illustrate the use of the internal-standard method in spectrographic assays of zinc, tin, lead and copper.

The book has been written almost entirely from the practical point of view, and is everywhere full of useful information for the practising spectroscopist. In addition to the usual index, there is a valuable bibliography of more than a hundred useful books and papers.

(3) Dr. Löwe, who is a section superintendent of the Zeiss works, is in a unique position to describe the design and applications of optical instruments. His first-hand knowledge has been used to good advantage in this book, and it is therefore perhaps ungrateful to grumble at the lack of illustrations of instruments designed in countries other than Germany. The treatment is rather more detailed than in Dr. Judd Lewis's book; the number of instruments described is considerably larger and some attention has been paid to grating instruments. It may perhaps be doubted whether the grating spectrograph with its feebler intensities is as useful to non-physicists as the more usual prism instruments. The author has not limited his treatment to purely spectroscopic matter, and in addition to the usual photometric methods for the determination of line intensities we are given sections on colour determination in liquids, fluorescence measurements, and turbidity measurements as applied to chemical and medical problems (nephelometry).

Very interesting are the sections on the applications of refractometric measurements in various problems of technical chemistry. Important subjects treated in this part of the book are oils, fats, sugars and starches, beer, pepsins, blood serums and milk. A final chapter deals with the uses of interferometry in problems of gas mixtures and solutions. Here again one may perhaps doubt whether the busy chemist will take the trouble to make use of this rather difficult branch

of applied physics. Surely in a book of this kind the reader should be given some account of the uses of polarimetry ? Dr. Löwe has unaccountably avoided this subject. Perhaps he will repair the omission in a later edition.

Many valuable numerical tables are included in the book, which is well printed and contains a good index.

Primitive Fossil Fishes

British Museum (Natural History). *The Cephalaspids of Great Britain*. By E. A. Stensiö. Pp. xiv+220+66 plates. (London : British Museum (Natural History), 1932.) 60*s*.

THE Cephalaspids are among the oldest fossil fishes which are known by nearly complete specimens. They are found in the Upper Silurian, Downtonian and Devonian fresh-water deposits of Europe and North America ; and they seem to have lived on the bottom like certain modern Siluroid fishes, which they much resemble in outward shape. They are specially important because the fossils exhibit not only the external armour, but also enough of the internal skeleton of the head and branchial region to reveal the arrangement of many soft parts. They thus make it possible to discover some of the fundamental characters of fishes in their beginning.

The best-preserved heads of Cephalaspids hitherto known are from the Downtonian rocks of Spitsbergen, and have been described in astonishing detail by Dr. E. A. Stensiö, of Stockholm. With these heads, however, there are rarely any fragments of the trunk. Dr. Stensiö has therefore now undertaken a study of the Cephalaspids from the Downtonian and Lower Devonian formations of Great Britain, in which the trunk is often present and sometimes well preserved. The structure of the head could not have been satisfactorily discovered from the British specimens alone, because in these the internal parts are less well ossified and fossilised ; but the dermal armour of the trunk and fins is almost completely displayed, and admits of detailed study and comparison.

Dr. Stensiö's results are published by the British Museum in one of the most sumptuous volumes ever devoted to a group of fossils. They are illustrated by sixty-six plates of unusually clear photographs, which have been obtained by specially devised methods ; they are also explained by numerous diagrammatic figures in the text.

In the chapter on anatomy, which extends to seventy pages, Dr. Stensiö interprets the British fossil heads by reference to the specimens from Spitsbergen, but adds new observations on the irregular vascular canals in the middle layer of the shield, which he thinks are supplemented by an elaborate system of mucus-producing canals in a more superficial layer. He also considers that the appearance of separate polygonal plates in the head-shield is due to the impress of a coarse network of mucus canals, distinct from the ordinary sensory canals which sometimes leave simple linear impressions on the surface. At the same time, he points out that the "radiating vascular canals" and the "ring sinus" which mark the edge of the polygonal areas in the head-shield, are seen again at the lines of junction in the transverse rows of scales on the trunk. His interpretation of the polygonal areas may therefore be wrong.

All satisfactory observations, however, confirm the conclusion that the Cephalaspids belong to the same great primitive group as the modern lampreys and hag-fishes, which are merely degenerate survivors. It is thus interesting to note that along the trunk in *Cephalaspis* itself, and in some other genera, a pair of ridges supported by simple scales seem to represent continuous paired fin-folds, of which the scaly pectorals form the only enlarged and differentiated portion. At least, the scales supporting these ridges are very like those which obviously represent the anterior dorsal fin in some genera. The Cephalaspids, indeed, so far as known, are almost ideally archaic fishes.

The systematic descriptions occupy half of Dr. Stensiö's volume, and he recognises many more species than have hitherto been admitted among the British Cephalaspids. He also adds two genera. He makes less allowance than previous authors have done for imperfections in the fossils due to crushing and fracture, and for possible changes during growth. Only experience in the naming of future discoveries can show whether his elaborate scheme of classification is justified. He has received valuable help from Mr. W. Wickham King in determining the geological distribution of the various forms.

Dr. Stensiö and the British Museum are indeed to be congratulated on this imposing contribution to our knowledge of British fossils, but one wonders what will be the extent of a palæontologist's library in the future if each little group is treated in a similar manner. A. S. W.

Short Reviews

The Chemistry and Physics of Clays: and other Ceramic Materials. By Alfred B. Searle. Second edition, revised and enlarged. Pp. xvi+738. (London: Ernest Benn, Ltd., 1933.) 55*s.* net.

THIS is the second edition of a book first published ten years ago. The same main divisions and chapter headings are again employed, although much of the contents has been rewritten to include a selection of the vast body of work published in recent years. The physics and chemistry of ceramic materials covers such an extensive ground that it is impossible for any one man to deal completely with it, or even to maintain exactly the same perspective in its different sections; specialists in each of the numerous restricted fields included in this book will, no doubt, find points for criticism. But ceramists, for whom it is primarily intended, are not immediately and directly concerned with current theories; they require information and guidance on practical points, and if they obtain a successful rule-of-thumb from some hypothesis that is incomplete or even wrong in some important particulars, their immediate need is satisfied. When the rule-of-thumb breaks down—as *ad hoc* solutions inevitably do, sooner or later—the theorist and the practical man are supplied with another point of reference for a more complete theory.

The author disclaims any intention of providing a critical scientific discussion of current theories, on many of which, indeed, there is wide disagreement; instead, he has merely retained a sufficient theoretical background against which the facts and processes of the ceramic art can be displayed. There is no doubt that the current and immediate future needs of the ceramists are best met by this arrangement and, to judge from the results of a number of test questions the reviewer put to the book, the author has fairly covered his embarrassingly wide subject.

The Human Problems of an Industrial Civilization. By Prof. Elton Mayo. Pp. vi+194. (New York: The Macmillan Co., 1933.) 8*s.* 6*d.* net.

PROF. ELTON MAYO approaches the human problems of to-day through a study of 'fatigue'. He shows that although it was once considered "a simple and special study", it is now known to embrace so wide a sphere as to make simple definition hopeless. He traces the development of industrial psychology along these lines in Great Britain, and pays tribute to the important and penetrating work of British investigators.

Several interesting experiments and investigations in an American factory are described in detail, and the gradually increasing round of problems leads to consideration of sociological problems and a conception of the 'new administrator'. Prof. Mayo concludes that the primary need of the industrial world is to develop a technique that will enable people to live in easy social relationships with each other. At the same time, every individual should have the right to feel that he is of economic value to the community. The whole of this most important aspect of human nature we have recklessly disregarded in our "triumphant industrial progress".

The book is excellent in that it shows psychological insight and wide reading, combined with sociological purpose.

The Fresh-Water Algæ of the United States. By Prof. Gilbert M. Smith. Pp. xi+716. (New York and London: McGraw-Hill Book Co., Inc., 1933.) 36*s.* net.

UNTIL the appearance of this volume, there was no recent work available on the algal flora of the United States. Its appearance thus marks a distinct advance in botanical literature and the more so as the North American genera of algæ are mostly represented in Europe and hence are of great interest to students in Great Britain.

The volume describes the characters and morphology of all genera of fresh-water algæ found in the United States and of the closely related forms present in the salt lakes. Species are not specially described, although characteristic and common ones are indicated and illustrated. All the genera are illustrated, and the illustrations, although occasionally somewhat generalised, are exceptionally clear. A notable and valuable feature of the work is that the keys are based, so far as possible, on vegetative characters, a method of great utility to the average worker. Altogether this is a book to be recommended to those interested in algæ.

Les textiles anciens du Pérou et leurs techniques. Par Raoul d'Harcourt. Pp. 170+108 plates. (Paris: Les Éditions d'Art et d'Histoire, 1934.) 180 francs.

IN this volume the author, who has already published a work dealing with more general questions relating to the ancient textiles of Peru, is concerned only with technique. In addition to his description of the various methods of producing the patterns by variation in the interweave, as described from the examination of the fabrics themselves, he has given a section dealing with embroidery. The methods described have been tested by the author in practice.

The technique of the Peruvian textiles appears to have attained an advanced stage at an early date. There is little variation throughout the whole pre-Inca period, that is, according to Kroeber's chronological estimate, so far back as the beginning of the Christian era.

The fabrics are illustrated in a lengthy series of admirably reproduced plates, each of which is accompanied by a detailed description.

New Acoustics Laboratory at the National Physical Laboratory

By Dr. G. W. C. Kaye, O.B.E.

ONE of the great social inconveniences in present-day life for large numbers of people is the lack of quietness which modern building design and materials have brought in their wake. The problem is accentuated in the case of the many large blocks of flats and apartment houses which are being erected, all around us, whether for the well-to-do or for the slum dweller. The question of acoustic isolation for the occupants receives little or no attention in the majority of cases, and it is a common source of complaint that purely local noises can be heard throughout the length and breadth of large buildings constructed on modern lines. Yet architectural acoustics is no longer shrouded in mystery and empiricism, but is a science of which some of the physical principles are well established, and the practical outcomes are often predictable. A good deal can, in fact, be done to mitigate the noise nuisance in buildings. The policy of perfection is, of course, to stop or lessen the noise at its source, but this may often be quite unfeasible. Alternatively, we must erect some kind of sound-proof barrier, whether wall, window or floor, between ourselves and the noise.

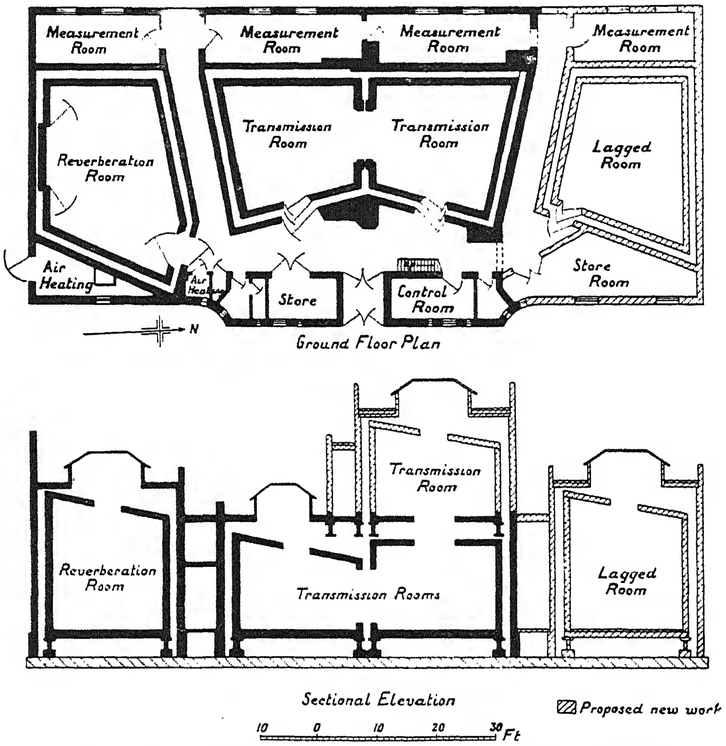

FIG. 1. New Acoustics Laboratory at the National Physical Laboratory.

In the case of sounds which arrive by air, the sound-proofing value of a single homogeneous wall or partition is wholly a matter of weight. High notes are easier to stop than low, but design counts for little or nothing. Unfortunately, the present tendency in building is to cut down both weight and thickness, and so for greater silence we must turn to composite structures, in which case design becomes all important. Such designs can only be appraised experimentally, for at present we cannot predict quantitatively their performance from a knowledge of their structure. Much remains to be done, but already designs are available, for example, of light, double air-spaced partitions, which are much more effective sound-proofers than single partitions of the same total weight. Cross-ties and incorrect separation of the components may be fatal to efficiency. This is illustrated by recent work at the National Physical Laboratory on double windows, which indicates that the separation for ordinary window glass should normally not be less than 4–6 inches, and that at smaller distances the insulating value drops to a minimum which may actually be less than that of one window alone. Apropos of windows, sound insulation is often quite incompatible with open windows, and forced ventilation may be the only solution in such cases.

When we come to deal with noises or vibrations which reach a room via the structure of a building, quite different measures are necessary. Vibrations may often be arrested near the source by resilient undamped devices so loaded as to be of suitably long period. Modern building structures contain noise-transmitting components of a high order—whether steel framework, ferroconcrete, cement-bound brickwork, hard plaster, water and radiator systems, sanitary piping, etc. Some form of discontinuity to arrest transmission has to be introduced, and in many cases the problems have still to be solved. Almost all forms of concrete flooring are noisy, and attention is now being given to floating floors, suspended ceilings and various types of floor finishes, to find an effective, yet economically feasible, solution.

The last stage in the attaining of a quiet room is to deal with extraneous noise which has succeeded in gaining admission or which is generated within the room itself. Something can be done to remedy the deficiency of absorbents in a too reverberent room by adding upholstery, curtains, thicker underfelts to carpets and so on. If these things are not in keeping with a room, then we can apply to the walls or ceiling one or other of the absorbents now commercially available, for example, fibre boards or porous plasters,

or one of the hair or asbestos felts covered with perforated or pin-pricked fabric which can be distempered or otherwise decorated. The effectiveness of the latter is noteworthy in that the area of the pin holes may be only a small fraction (less than 1 per cent) of the area of the fabric.

The foregoing will give a notion of some of the acoustical problems which confront the architect, the building industry and the acoustical engineer. It is not impossible that measures to reduce noise to the level demanded by the public may necessitate serious modifications in the accepted methods of construction. Adequate facilities for carrying out investigations on full-scale floors and partitions have not hitherto existed in Great Britain, but the Department of Scientific and Industrial Research has recently embarked on a programme of research, and a start has been made to provide the necessary facilities in the shape of a new acoustics Laboratory which has been designed at the National Physical Laboratory, with the co-operation of H.M. Office of Works.

The laboratory, which was open for inspection on the occasion of the annual visitation on June 26, will ultimately form part of the Physics Building. Complete acoustical and electrical isolation is aimed at in the case of the experimental rooms, these at present comprising a reverberation room and a pair of transmission rooms, each with its own measurement room for the operator during the actual observations. Fig. 1 shows a sectional plan and elevation. As will be seen, the enclosing walls, floors and ceilings are of massive masonry, and everywhere double, the inner shell being completely independent of the outer and resting only on insulating piers on separate foundations. The insulation in the piers is slab cork, and provision has been made for the hydraulic lifting of the inner rooms (which weigh 150–200 tons) so that should the cork deteriorate under the sustained heavy load it can be renewed.

Acoustic absorption coefficients have been determined in temporary accommodation at the Laboratory for some years, but unique facilities for the work are now provided by the new reverberation room. This is asymmetric both in plan and elevation: the walls are not parallel nor is the ceiling horizontal, thus assisting in minimising the influence of the natural transverse resonances of the air in the room, as well as promoting the uniform and random distribution of sound which the several reverberation formulæ postulate. The even distribution is furthered by the use of a warble note as a source of sound. The walls of the room are finished in painted hard plaster, and the closely-fitting double entrance doors are each of solid steel, the inner being $3\frac{5}{8}$ in. thick and the outer $2\frac{1}{2}$ in., and correspond in superficial weight to the adjacent walls. The shutters to the skylight, which are of similar construction, are electrically operated from below.

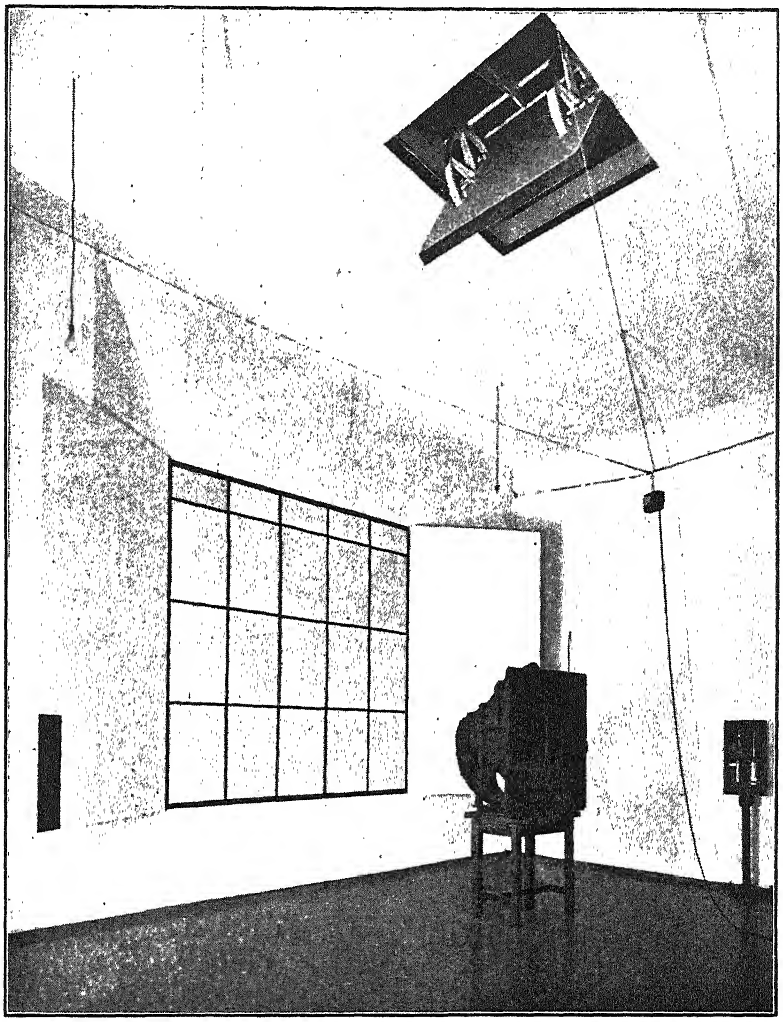

Fig. 2. Reverberation chamber showing loud speaker, microphone and test panel of which the acoustic absorption coefficient is required.

The volume of the room is about 10,000 cubic feet, and the Sabine reverberation period for a note of 512 cycles per second is about 13 seconds when the room is empty. In one of the walls are steel swing doors (see Fig. 2) covering a shallow recess in which is mounted 100 square feet of the

material, the acoustic absorption coefficient of which is required. A loud speaker produces one of a range of notes of frequencies from 125 to 4,000 cycles per second, and in each case a microphone and amplifier system affords the decay curve of the average intensity in the room with the test absorbent alternately exposed and covered up by the doors. A thyratron relay device automatically records the decay period for any preselected intensity drop of decibels. If the air of the room is appreciably humid, it may contribute markedly to the absorption of sounds of frequencies above about 2,000.

The values of absorption coefficients are known to be susceptible to a variety of influences and the Laboratory is participating in an international inquiry into the dependence of absorbing power on the size, shape and distribution of a test material, its thickness and porosity, the method of mounting, the degree of separation from a backing wall and so on.

The two transmission rooms are on independent foundations, and are of the same irregular shape and general construction as the reverberation room, except that the entrance doors are triple and of solid wood. The test aperture, which is shown in Fig. 3, will take specimens up to about 10 ft. × 8 ft. These are either erected *in situ* or assembled elsewhere and then mounted in position by the aid of the clamps shown. A runway is provided for transporting heavy specimens. Tests are normally conducted with an exploring microphone in each room and a loud speaker in one of the rooms, a warble note with a selection of frequencies between 100 and 4,000 cycles per second being employed. The position of the microphone can be controlled from the adjacent measurement room and the oscillator exciting the loud speaker together with the microphone and associated amplifier are wholly operated from the electric supply mains. Provision is made so that the walls of the rooms can either be used in a reflecting state, when tests are made with sounds at random incidence, or covered with absorbent when a beam of sound is used. The rooms can readily be adapted for testing the sound attenuation in ventilation ducts and silencers as well as for studying the quietening of machinery.

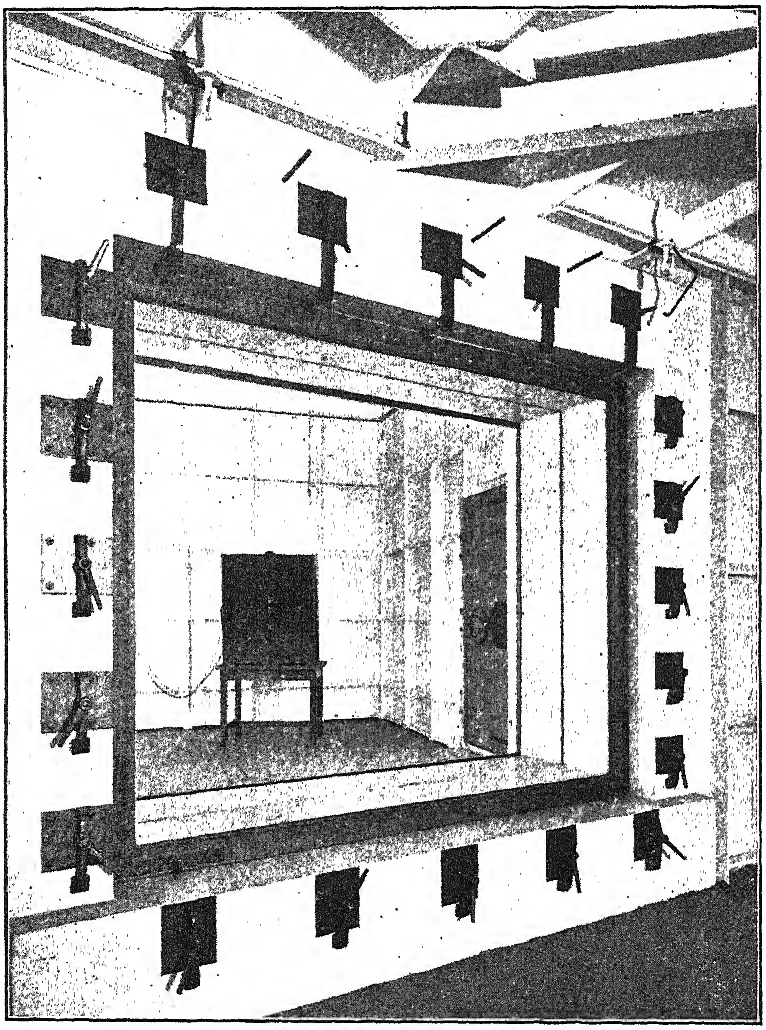

FIG. 3. Transmission rooms showing test aperture for measurement of acoustic isolating values of walls and partitions.

The ventilation of the building is by pressure feed, and constant-temperature heating in the experimental rooms is aimed at by passing warmed air between the double walls. Concentric cable is used in the wiring of the experimental equipment, and when desired, the entire building or any selected section of it can be rendered electrically isolated by cutting off all external power supplies, requirements being then met from a battery.

It is hoped that it will not be long before an upper transmission room is erected (see Fig. 1) so as to permit acoustic tests on floors for which provision has been made by constructing a ceiling aperture to take floor specimens 8 ft. × 7 ft. and upwards. In the meantime, provisional arrangements are being contrived. A room with heavily lagged walls is also contemplated to provide for the absolute calibration of microphones and other purposes. The investigations in the new Laboratory will be implemented by 'field tests' on actual buildings so as to take into account the factors of construction and workmanship.

Annual Meeting of the Royal Society of Canada

THE Royal Society of Canada held its annual meeting on May 20–24, at the Chateau Frontenac, Quebec. Appropriate to the occasion of the fourth centenary of the discovery of Quebec, the president, M. Léon Gérin, delivered an address on "Jacques Cartier, notre découvrier". At the same meeting, the Flavelle Gold Medal was presented to Prof. L. V. King for his contributions to mathematical physics, the Lorne Pierce Medal for achievement in literature to F. P. Grove, and the Tyrrel Medal in historical subjects to J. C. Webster.

At the meetings of Section I (French Literature, History, etc.) eighteen papers, and of Section II (English Literature, History, etc.) sixteen papers were presented.

Prof. F. M. G. Johnson, professor of inorganic chemistry in McGill University, was president of Section III (Mathematical, Chemical and Physical Sciences). Owing to the fact that 161 papers were presented, the section was divided into three sub-sections, which met simultaneously in different rooms. Only a few papers of general interest were presented to the joint meeting of the section. Dr. J. S. Plaskett and J. A. Pearce gave a paper in which new evidence was presented indicating that our galaxy is similar in dimensions and structure to the Great Nebula in Andromeda. New concise methods for the rapid transformation of partial second derivatives in thermodynamical problems were presented by Prof. A. N. Shaw. Sydney Sillitoe gave the results of a series of measurements of reflections from the ionosphere using a new automatic method of tuning the antenna of the transmitting circuit which produces a sharp symmetrical wave pulse that was received on the usual type of cathode ray recorder situated two miles from the transmitter.

Among the papers presented by Prof. E. F. Burton and his collaborators, mention should be made of one on supraconductivity in which it was shown that films of supraconducting materials, when coated with thin films of non-supraconducting metals on the outside, lose the power of becoming supraconducting. R. W. McKay presented the results of a long series of careful measurements on the dielectric constant of conducting solutions of sodium chloride, copper sulphate and magnesium sulphate for a frequency of 2×10^6. A new method of quantitative micro-analysis was given by Dr. J. S. Foster and G. O. Langstroth, in which quantities of lead of the order of 10^{-8} gm./c.c. were measured in the spinal fluid.

In the Mathematics Sub-Section, Prof. L. V. King presented papers on acoustic radiation pressures on spheres which gave an adequate explanation of the dust figures observed by Prof. R. W. Boyle and his collaborators in the neighbourhood of piezoelectric oscillators operated at supersonic frequencies. The results of mathematical investigations on the effect of viscosity on the transmission of acoustic radiation and an extension to the theory of the Rayleigh disc were also presented by Prof. L. V. King. The paper by Prof. A. F. Stevenson on the theory of current flow in heterogeneous earth was of interest to geophysicists.

In the Chemistry Sub-Section, Prof. C. F. Allen and his collaborators read a paper on the preparation and reactions of the simplest δ ketonic nitriles. Prof. W. Lash Miller read a number of papers on 'bios', and Prof. R. H. Clark, R. G. D. Moore and M. McArthur described the preparation of ten new derivatives of cinnamic acid and ortho-phenyl-phenol. The oxidation of methane at pressures between 100 and 200 atmospheres has been investigated by Prof. E. H. Boomer and J. W. Broughton, who find that methanol is the principal product. Dr. E. W. R. Steacie and E. Solomon read a paper on the decomposition of gaseous ethyl ether at pressures up to 350 atmospheres. Among the papers presented by Prof. Otto Maass, a series of experiments on the properties of liquids and vapours at the critical temperature were of especial interest. In collaboration with E. H. Morris, the new experimental technique which has been devised for measuring such properties as dielectric constant, refractive index and density was described, and it was shown that discontinuity exists between the liquid and vapour heated above the critical temperature.

In the Physics Sub-Section, investigations on the age of certain minerals, as determined from the radii of the rings in pleochroic haloes, were described by Prof. G. H. Henderson. The results are in fair agreement with the ages determined by the uranium–lead content. Prof. J. A. Gray spoke on the scattering of X-rays at small angles; experiments in collaboration with W. E. Bennett have indicated the presence of two distinct types of intense scattered radiation. One type is attributed to diffraction by small prisms, or spheres, and the other to a gas of high molecular weight. R. M. Stewart gave experimental formulæ for the law of decrement for the oscillatory motion of pendulums under atmospheric pressure. The results of a geophysical survey made with torsion balance and magnetic variometers in northern Ontario were presented by A. H. Miller. The presence of a dyke lying under 30 ft. or more of overburden, was indicated by both methods used. In a paper read by A. H. Snell, it was shown that about 350 lines in the molecular spectrum of hydrogen gave measurable Stark effect displacements in a field of 90,000 volts/cm. The successful use of photoelectric cells in the experimental determination of the velocity of projectiles was described in a paper by D. C. Rose. Prof. E. F. Burton and his collaborators presented a number of theoretical and experimental papers on hyperfine structure, nuclear moments, X-rays and atomic statistical fields, but space does not permit their discussion.

Meetings of Section IV (Geological Sciences) were attended by twenty members and some dozen non-members, including officers of the Geological Division of the Quebec Bureau of Mines. Announcement was made of the award of a Royal Society Carnegie fellowship to V. J. Okulitch, of the University of British Columbia and McGill University, who proposes to carry on research at Harvard University.

Twenty-six papers were read or presented by title at the several sessions. Among those which evoked the most interesting discussion may be mentioned papers by J. S. DeLury, on geothermal gradients and on the mechanics of igneous intrusion, and one by Prof. E. L. Bruce on the spectrographic examination of quartz from some gold-bearing quartz veins. Prof. G. H. Henderson gave a summary, illustrated by slides of photomicrographs, of two papers on pleochroic haloes in biotite, and a method of calculating from them the age of the mineral—papers he had presented before Section III of the Society. Prof. Henderson's talk was of considerable interest, and was followed by an informative discussion.

On May 23, twenty members and friends joined in a geological excursion to Levis and vicinity, conducted by Dr. B. T. Denis of the Quebec Bureau of Mines and Prof. T. H. Clark, and on the following day a number of members, at the invitation of Dr. John A. Dresser, visited the Notre Dame Mountains of Quebec, examining especially the rocks of the Serpentine Belt.

The presidential address delivered by Prof. Marie-Victorin before Section V (Biological Sciences) dealt with the flora and ecology of the different sections of the St. Lawrence River. Dr. Huntsman presented two interesting papers on the life and feeding habits of the Fundy salmon and herring respectively; apparently neither of these fish normally migrates so widely as has been supposed. A paper by R. E. Foerster reported reciprocal crosses of the five species of Pacific salmon. Several botanical papers contained results of more than usual significance. One by G. A. Ledingham announced that the zoospores of members of the Plasmodiophorales are biciliate, not uniciliate as hitherto described, and that one cilium is much shorter than the other, indicating less affinity with the Myxomycetes than has been supposed and perhaps, as was suggested in the discussion, descent from algal Heterokontæ. Further evidence of polyphyletic origin of the Fungi was contained in a paper by H. S. Jackson which demonstrated close similarity in the life cycles and sexuality of Uredinales and Rhodophyceæ. Experimental plant embryology was the subject of a paper by Prof. R. B. Thomson, who described how the haustorium of *Marsilea* embryos develops spherically instead of in the typical cap shape when grown in culture fluid. Prof. G. W. Scarth gave evidence of a remarkable increase in cell permeability (to urea, etc.) in plants which have become hardened to frost. A useful and comprehensive summary of work done in the U.S. Department of Agriculture on cereal rust in relation to the physiology of the host was given by Dr. H. B. Humphrey.

The papers presented to the Medical Sciences Sub-Section covered an exceptionally wide range of topics. Sir Frederick Banting's group have continued their work on silicosis with the development of valuable new methods of attack on the problem, and have found important experimental evidence against the view that sericite, rather than silica, is the harmful substance. Outstanding among a number of communications from the Connaught Laboratories was an exhaustive quantitative study of the diphtheria-antitoxin content of human sera in various circumstances, by Dr. D. T. Fraser. Prof. J. B. Collip and his collaborators presented a series of papers on anterior pituitary hormones, among which Dr. Hector Mortimer's X-ray studies on experimentally produced changes in the rat's skull were noteworthy. Another group of papers was presented by Prof. C. H. Best, and included an account of different crystalline metallic salts of insulin by Dr. D. A. Scott. Prof. F. R. Miller reported on the effects of unipolar faradisation of the caudate nucleus; Dr. G. F. Marrian described improved methods for the isolation and chemical assay of œstrin; and Prof. C. C. Macklin strikingly demonstrated the existence of communicating pores, in the alveolar walls, between different lobules of the lung.

Obituary

Dr. Marion I. Newbigin

We regret to record the death of Dr. Marion Isabel Newbigin, which occurred in Edinburgh on July 20. The removal of her outstanding personality marks a severe loss to geographical science in Great Britain, for she exerted a powerful influence upon the development of geography throughout the present century, by her own writings and teaching as well as by her admirable editing of the *Scottish Geographical Magazine* since 1902.

Dr. Newbigin, who was born at Alnwick in 1869, was one of a group of pioneer women who received university training in natural science, and after studying at University College, Aberystwyth and at the University of Edinburgh she graduated as a B.Sc. of London in 1893. Devoting herself to zoology, she quickly established a reputation by her work on pigmentation in animals. She published papers on colour in two groups of birds (Trochilidæ and Nectariniidæ), others upon the pigments of decapod Crustacea and of the muscle of salmon. For this work and for her book "Colour in Nature, a Study in Biology" she received the degree of D.Sc.(Lond.) in 1898. Her interest in marine fauna is indicated by two papers

and by the volume "Life by the Sea Shore, an Introduction to Natural History" (1901). Although Dr. Newbigin then turned to the rapidly developing subject of geography, she maintained contact with biology in the Royal Physical Society of Edinburgh, of which she had been secretary and president, and as extra-mural lecturer on biology at the Womens' Medical School in Edinburgh until 1916. She published a work on animal geography (1913), and over a long period acted as assistant editor of the *Journal of the Royal Scottish Arboricultural Society*.

Dr. Newbigin brought her knowledge of environmental influences to bear upon the study of human activities with great effect; and her numerous geographical writings possess special value because of this. Her earlier books, which were of a general character, included "Tillers of the Ground" (1910); "Modern Geography" (1911); and "Man and his Conquest of Nature" (1912). She travelled widely, and methodically built her careful observations into a series of valuable regional interpretations. Of special note are her works on southern Europe: "Geographical Aspects of Balkan Problems" (1915); "Mediterranean Lands" (1924); and "Southern Europe" (1932).

As a lecturer in geography, Dr. Newbigin was in great demand, and in recent years she gave regular courses at Bedford College, University of London. She rarely missed an International Geographical Congress, and she attended the meetings of the British Association regularly, presiding over Section E in 1922. She was the recipient of the Back Grant of the Royal Geographical Society in 1921 and the Livingstone Gold Medal of the Royal Scottish Geographical Society in 1923. The latter Society is especially in her debt for her loyal service and her unremitting labour in maintaining the high standard of its *Magazine* for thirty-two years.

WE regret to announce the death of Mr. H. Glauert, F.R.S., principal scientific officer at the Royal Aircraft Establishment, Farnborough, author of numerous papers on aerodynamics, on August 4, aged forty-one years.

News and Views

Prof. E. G. Coker's Retirement

PROF. E. G. COKER, who is this year retiring from the Kennedy chair of civil and mechanical engineering in University College, London, was appointed to his chair not long before the outbreak of the War, which found him in Australia, where he had gone as president of Section G of the British Association. In common with a number of other scientific workers, he had some unexpectedly exciting experiences on that occasion, narrowly escaping capture by the German cruiser *Emden*. Prof. Coker went to University College from the City and Guilds Technical College, Finsbury, where for some years he was the colleague of Silvanus Thompson, who was associated with some of his earlier work on polarised light. Before that time he was associate professor of civil engineering in McGill University, Montreal. Prof. Coker's name is chiefly associated, in the minds of engineers, with the direct exploration of stress in machines and structures by means of polarised light, a field which he has made peculiarly his own and which has been largely built up by his own efforts.

THE double-refraction caused by stress in transparent materials was discovered more than a century ago by Sir David Brewster, and the suggestion that this effect might be used to discover the stress-distribution in such materials was actually made by Brewster himself. Attempts in this direction were undertaken at various times, for example, by Clerk Maxwell, Carus Wilson, Mesnager and others, while the laws underlying the phenomenon have been investigated by a number of physicists. It was left to Coker, however, to develop the method, and to make it, by a variety of skilful contrivances (in particular his lateral extensometer), into a really practical one. To him is due also the use of an easily workable material like celluloid for such investigations. By this means he has been able to solve a number of important problems relating to contact stresses, gears, test-pieces, architectural structures, etc., where mathematical analysis proved either inadequate or too complicated. For this work he created, at University College, a first-class research laboratory, which has attained a world-wide reputation. His recent treatise on "Photo-Elasticity", written in collaboration with his colleague, Prof. Filon, gives an exhaustive account of this subject, and embodies the results of a quarter of a century of continuous research. It is much to be hoped that this work will not be interrupted by Prof. Coker's retirement, and that he will continue, with unabated vigour and activity, to enrich engineering science in his chosen field.

New Vice-Chancellor: University of Melbourne

MR. R. E. Priestley, fellow of Clare College, Cambridge, and Secretary General of the Faculties of the University, has been appointed Vice-Chancellor of the University of Melbourne. Mr. Priestley was educated at Tewkesbury Grammar School and entered the University of Bristol in 1905. In 1907 he joined Shackleton's *Nimrod* Expedition as geologist. On returning from the Antarctic in 1909 he spent a year as a research student at the University of Sydney, working up the results of the expedition with Prof. Edgworth David. The sudden illness of Scott's geologist led to Priestley joining Scott's last expedition one week before the boat left Sydney. From 1910 until 1913 he was scientific observer with the northern party, first at Cape Adair, then at Terra Nova Bay. During the latter period

he spent a winter in a snow cave on half rations. On his return from the south in 1913, Priestley entered Christ's College, Cambridge, as a fellow commoner and research student with the view of working up the results of the expedition. On the outbreak of the War, Priestley was commissioned in the London Wireless Signal Section and served in France. At the end of the War he spent some fifteen months writing the official history of the signal service in the War. On returning to Cambridge he studied for the agricultural diploma and was appointed lecturer in soil science. In 1923 he was elected a fellow of Clare College.

SINCE then, Mr. Priestley has devoted himself almost entirely to administrative work. In 1923 he was appointed secretary of the Board of Research Studies, in 1926 secretary of the Board of Examinations, and in the same year secretary of the newly constituted General Board of Studies. In all these offices Mr. Priestley has been a conspicuous success. The introduction of the new University statutes altered the whole character of the General Board of Studies. The magnitude and importance of the work of the Board has steadily grown during the past eight years, and in the spring of this year a new statute was approved creating a new office of Secretary General of the Faculties, an office which was placed in Schedule B. Mr. Priestley was appointed first Secretary General of the Faculties and appointed to a professorial fellowship at Clare College. As secretary of the Board of Research Studies he has been of very great help to the large number of research students at Cambridge, more particularly to those from abroad. Many of them will welcome him on his arrival in Australia. His departure from Cambridge will be a great loss both to his College and to the University, but he will carry with him the best wishes of his many friends at Cambridge, who are confident that the University of Melbourne will gain very greatly by his appointment.

Food Research

IN a paper on "the Research Movement and its Modern Developments", read at the spring meeting of the Manufacturing Confectioners' Alliance and the Food Manufacturers' Federation at Harrogate on May 13, Mr. A. L. Hetherington reviewed the way in which scientific research was being applied alike to industrial processes and to everyday life. Particular reference was made to the work being carried out under the Department of Scientific and Industrial Research through the various Research Associations, and more especially to the work of the Cocoa, Chocolate, Sugar Confectionery and Jam Manufacturers and of the Food Manufacturers' Research Association. The successful solution of the problem of bloom on chocolate was the result of a concentrated attack by a team of workers at the problem. Methods have been found of preventing mould growth and fermentation in jams, jellies, fondants, etc., without using prohibited preservatives, and the discovery of a method of slowing down the breakdown of the sugar in reheating sugar syrups has led to considerable savings in the use of high-grade sugars. Effective work has been done to combat infestation by the cocoa moth and other pests, and the Research Association's work has not only tended to raise the quality of the goods produced but also stimulated interest in the application of science and in the underlying principles of manufacture. In the view of the Advisory Council, no Research Association should be operating on a smaller scale than a minimum income of £10,000–£20,000 per annum, and Mr. Hetherington urged fuller support for the two food associations to raise their income to this minimum from the present inadequate £7,000 and £2,000 per annum.

Electric Shut-Down in London

THE sudden cessation of the supply of electricity over London and part of the south-east of England during midday on July 29 proves that even with the best machinery a breakdown in the supply is a possibility that has to be guarded against. Luckily it is an extremely rare occurrence. The trouble started apparently when the engineers were rearranging sections of the supply at the Battersea power station. A small section becoming overloaded, the automatic circuit breaker came into action. When the circuit breaker was closed the currents in two of the sections were probably not in synchronism and so a huge current circulated in the link connecting Battersea with the neighbouring station at Deptford West. The former had an output of 70,000 kilowatts at this moment and the latter of 90,000. The devices at Battersea declined to take the short circuit load, and several of the machines at Deptford shut down. The Barking Power Station had now to take the load, but the circuit breaker at Northfleet opened and the whole system ceased to operate. The effect was that the whole of the south-east area of the grid was suddenly deprived of 280,000 kilowatts of generating plant. The stations at Norwich and Brighton cleared themselves from the grid, the latter for about an hour. This affected the Southern Railway. The trouble was probably caused by the engineers taking advantage of the light load in summer to cut out certain transmission connexions for overhauling and so the grid system was not in full commission. It was not able to face the loss of Battersea, Barking and Deptford and still keep the whole system working. Notes on this shut-down are given in the *Electrical Times* of August 2.

Early British Camp

AN important discovery of, it is conjectured, either an early British camp or the site of the capital of one of the Kentish kings, is announced in the *Times* of August 6. The site is at Bigberry Woods, near Canterbury, and its exploration, which will occupy two seasons, has been undertaken by a committee, of which Lord Conway of Allington is chairman and Messrs. R. F. Jessup and N. C. Cook of the Maidstone Museum are the joint directors. A number of accidental finds have been made there in the past,

including a glass jug (Roman) and a large earthenware pot. Other finds have been made—chariot harness and gear, a slave charm and implements. It is thought that the position, occupying about 25 acres on the top of a hill, being a natural strong point, may have been held as a camp up to the time the Romans occupied the valley where Canterbury now stands. Cuttings have been made on the north side and have brought to light a ditch filled with rubble, broken earthenware and vegetable matter. The excavators have also found a rampart and a black occupational level which contains much broken pottery. More pottery was found in a cess-pit, but a cooking pit, flint-lined, serving a group of wattle and daub huts, contained little pottery. Excavations have also been begun on the south side, whence most of the previous material has come.

Control of the Bed-bug

THE Ministry of Health has recently issued two brochures dealing with the bed-bug, its habits and methods of eradication. While this insect is not known to be actually concerned with the transmission of the pathogenic organisms of any specific disease, its presence in large numbers is a menace to humanity. The insect is perhaps responsible for ill-health from lack of sleep due to skin irritation, and its presence accentuates the already insanitary conditions under which it thrives. During recent years, the problem of its eradication has come more and more into prominence in connexion with slum clearance and other schemes. A large number of tenants of 'council houses' come from verminous dwellings, and the need for ensuring that the new houses are not similarly infested from the outset is a matter of concern to the local authorities. A report of the Committee on the Eradication of Bed-bugs has recently been issued (Reports on Public Health and Medical Subjects. No. 72. 1934. 46 pp. H.M. Stationery Office, 1*s*. 0*d*. net). This Committee, under the chairmanship of Dr. G. W. Monier-Williams, has, in its report, summarised the present position and indicated the lines along which future work on bed-bug control might be profitably undertaken. The life-history of the insect is discussed, and various methods of control are dealt with. In view of the lack of accurate information as to the bionomics and habits of the insect, various lines are emphasised along which research requires to be carried out. The report is accompanied by two well-executed coloured plates, illustrating various phases in the life of the insect, together with an excellent annotated bibliography.

THE second brochure issued by the Ministry of Health on this subject (Memo. 180 Med.) is entitled "Memorandum on the Bed-bug and how to deal with it". It is intended for official use and has been prepared with the view of assisting sanitary officers and others in dealing with bed-bugs. It outlines the biology of the insect, gives instructions where to seek the insects, and cites the chief means of prevention and the best methods of extermination. For fuller information on the subject the report, already mentioned, should be referred to. The memorandum is accompanied by the same coloured plates as are appended to the report. We welcome the appearance of these two publications since they supply, in non-technical language, accurate and up-to-date information on a long-standing problem. Its full solution is dependent upon research carried out along the lines indicated, and much remains to be done. Relatively little is known, for example, of the effects of climatic conditions on the breeding of the insect, or as to the extent to which it can survive on the blood of other animals in the absence of human beings. There is, also, much yet to be discovered with regard to the differential action of insecticides on the insect and its eggs. The effects of heavy infestation of bed-bugs on the general health of the people are still not properly understood, and there is real need for definitely ascertaining whether, under certain conditions, bed-bugs may prove to be the carriers of disease germs.

A New Skymeter

IN these days when many of our great cities are involved in so much rebuilding, the question of light easements of adjoining property frequently gives rise to the necessity for financial settlements or building restrictions involving a definite assessment of rights of light existing. Speaking generally, the law recognises that light enjoyed over a sufficient period, so far as the use to which the particular space lighted is usually put, cannot be materially encroached upon without some form of compensation. At one time, cases in the courts depended on such general evidence as could be brought forward; more recently, geometrical methods have been worked out whereby the actual illumination can be measured. These methods are laborious, and Mr. A. S. E. Ackermann, 17 Victoria Street, London, S.W.1, sends us particulars of an invention for determining sill ratios which involves neither photographic nor photometric work. It consists of a pane of clear glass attached to two adjustable radius bars, the whole mounted on a stand. This is set up to face the window in question with the centre of the glass at the middle of the sky area. The sine of the elevation is read and the sky area traced on the glass, the observer using a pinhole eyepiece. This diagram is transferred to tracing paper and the sky area measured by a planimeter. This area multiplied by the sine of the elevation angle and divided by a constant gives the sill ratio. The instrument is portable and weighs less than 9 lb.

Skating Rinks and Wave Bathing Pools

ICE skating rinks and wave bathing pools, being used mainly for pleasure, have until quite recently not been seriously studied from the engineering and scientific point of view. The Dolder ice skating rink at Zurich which was opened four years ago has proved such a success that Zurich is now the centre of the ice sports in Switzerland. In the *Escher-Wyss News* of May 1934, D. Mettler describes the open-air skating rink and wave bathing pool in Berne and

points out some of the considerations that lead to commercial success. A good natural water supply is essential as a supply from the town services can never be counted on. The ideal site should be in the vicinity of a wood and on the northern side of a hill as this makes the formation of ice less expensive. It is also advisable, as at Berne, to combine with the ice rink a bathing establishment for summer use. In Zurich the ice rink is combined with a swimming bath which serves in winter as the water tank for the ice rink. Concrete, iron, copper, cork and bitumen are used in the construction of the freezing plate. As their thermal coefficients of expansion are all different and the temperature fluctuations are large the problem presented difficulties. Owing to the thermal expansion, countless minute cracks appear on the plate and this luckily allows it to 'breathe' without injuring the network of tubes. The production of artificial waves in a bathing pool has been studied for many months in the hydraulic laboratory of Messrs. Escher Wyss. They now produce special plant called the 'undosa' for the economic production of artificial waves. Neuchâtel has an open air skating rink, and it appears that it is only lack of capital which prevents other Swiss towns from carrying out similar schemes.

The Science Museum

In its annual reports to the Board of Education, the Advisory Council of the Science Museum, while giving a general review of the progress of the Museum as a whole, has usually devoted special consideration to one of the divisions, directing attention to the gaps in its collections and indicating how the collections should be developed. In its report for 1933, the Council has therefore dealt with the important sections Water and Air Transport, and its remarks go to show that unless steps are taken there is likely to be wasteful rivalry between the Science Museum and other museums supported by the State. Some of the aeronautical exhibits, the report says, are on loan from the Imperial War Museum and others from the Air Ministry. When the War Museum moves to its new quarters at Bethlem it may wish to withdraw its exhibits, while the Air Ministry is contemplating setting up a museum of its own. "This would inevitably create three exhibitions of aviation, each incomplete, and in competition with one another." The creation of the War Museum has already had an unfortunate effect on the Water Transport Collections, for as a result of its inauguration "practically no models of men-of-war of the period between 1914 and 1920 are available, and consequently the collection in the Science Museum is completely truncated. It is regrettable," the report says, "that in this, as in other cases, national collections of the same subject matter should be split up between different Museums, and thus lose much of their educative value to the public." Another rival of the Science Museum, not referred to in the report, may well be the National Maritime Museum, which must almost inevitably encroach on some of the territory already occupied by the Science Museum.

History of Self-Starters for Motor-Cars

The Smithsonian Institution has received from the V. G. Apple Laboratories, Inc., of Dayton, Ohio, a valuable collection of early automotive electrical equipment. The founder of the firm, the late Vincent G. Apple, was one of the pioneers who improved motor-car ignition and lighting systems, and one of the first to produce a successful electric starter. This starter, which was very cumbersome, was listed in 1912 at 350 dollars. To-day, when practically every car has a self-starter, the advertising leaflets are amusing. "Every successful device for the public amusement passes through a period of such enormous popularity that the public overlooks its many imperfected details in the desire to be among the first to possess it." It is pointed out that the necessity of cranking the engine of a motor-car is a most exasperating drawback. Compressed air, gas, acetylene gas and spring starters have all been tried and, except when everything is favourable, they have been found untrustworthy. A starter is a convenience when a car is leaving the garage; it is a necessity when it stops at a busy street corner, but what about starting the car when it stops on a level crossing? The progress of perfecting these devices during the last few years has been so rapid that there is a danger of the beginning and intermediate steps being forgotten. The Smithsonian, therefore, is gathering a collection, as complete as possible, of lighting, starting and ignition equipment.

The American Institute of Electrical Engineers

In commemoration of the fiftieth anniversary of its foundation, on May 13, 1884, the American Institute of Electrical Engineers has issued a very interesting memorial number of *Electrical Engineering*, representing the official monthly journal and transactions. This number, published in May, and containing more than two hundred pages, is dedicated "To the lasting memory of those public spirited leaders who founded and built to its present eminence the American Institute of Electrical Engineers, and to the inspiration of those of the present and future generations who will continue the constructive leadership of this agency for professional development". Among the famous names of contributors to this issue are those of A. E. Kennelly, who writes on "The Work of the Institute in Standardization", C. A. Adams on "Some Major Events in the Life of the Institute", E. W. Rice, Jr., on "A Century of Progress in 50 Years", M. I. Pupin on "The Equation of Electrical Propagation", while Elihu Thomson and D. C. Jackson deal respectively with "Some High Lights of Electrical History" and "The Evolution of Electrical Engineering".

These articles are most useful accounts of progress, and provide an illuminating perspective of the manner in which the electrical engineering industry has attained its present status through the continued effort of the comparatively few, of whom the foregoing names are representative. The biographical notices are no less than 92 in number; England

being well represented by the names of Heaviside, Kelvin, Preece and S. P. Thompson, all of whom were honorary members of the American Institute. The publication is a very fitting tribute to the pioneers whose work is so admirably appraised by C. F. Scott, a former president of the Institute, in the following words: "In the fabric of electrical engineering the long scientific threads of the warp are bound together and given pattern and utility by cross threads which are the life achievements of individuals. As the loom keeps weaving through the years new threads of scientific knowledge are added to the old, and new workers contributing woof of finer quality enrich the beauty and enhance the utility of the product."

Drought of 1934 in the United States

"By the close of May 1934 the most extensive drought in the climatological history of the United States had developed in the central valleys, the Lake Region and the North-western and Western States," states J. B. Kincer, Chief of the Climate and Crop Weather Division of the U.S. Weather Bureau, in the *Scientific Monthly* of July, p. 95. In North Dakota the three spring months (March–May) yielded only 1·25 in. of rain, against the previous low record of 2·15 in. in 1901. In the north-west the serious shortage in sub-soil moisture and surface water supplies is the result of an accumulated deficiency covering several years. There is no reason to suppose, however, that this prolonged deficiency indicates a permanent drift towards desert-like conditions; for long-period records show that periods of excessive drought may be expected to occur at intervals of 30–40 years. Thus similar periods of years with markedly deficient rainfall covered the ten years ending with 1864 and again the ten years ending with 1894, while between these periods were successive years with comparatively abundant rains. The 1934 drought was unusual in developing early, and as a consequence, instead of the corn crops being most seriously affected as occurs in summer droughts, the crops which have suffered most so far are hay, pastures and small grains.

Meteorology in Southern Rhodesia

According to the meteorological report of the Department of Agriculture, Southern Rhodesia, for the year ended June 30, 1933, there was comparatively little change, up to October 1, 1933, in the number of observing stations representing that country, thirty-six new stations having been opened and twenty former stations altered or closed, the total number on that date standing at 601, of which all but fifty are rainfall stations. The seasonal rainfall was below the normal, as was that of the three preceding seasons with the exception of 1931–32, the deficit being nearly 4 inches. For the fourth year in succession, the seasonal rainfall was forecast with the aid of a formula based on the values of meteorological data at distant 'centres of action', and the sign of the departure from the average was successfully predicted again as at the three earlier attempts—a very praiseworthy result. The report in its general lines follows those of the earlier years. Monthly means of barometric pressure, of temperature and of relative humidity for each of the twenty-four hours are given for Salisbury and Bulawayo, and monthly sunshine totals for the daylight hours; the distribution of rainfall for the whole period is shown cartographically in colours, and there are many climatic summaries on standard lines. There are also summaries of the upper winds measured with the aid of pilot balloons, and of the records of pressure tube anemometers situated at Salisbury and Bulawayo. Dines pressure-tube anemometers have been erected during the year at Fort Victoria, Que Que and Miami. Very satisfactory progress in the collection of comparable climatic data for this country is revealed by this well-arranged and clearly printed report.

The Periodic Law

The Mendeléeff Centenary Lecture was delivered before the Chemical Society at the Royal Institution on April 19 by Lord Rutherford, and is printed in the *Journal* of the Society for May. Lord Rutherford gave an account of the researches on atomic structure which have led to a realisation of the true meaning of the Periodic Law (see Nature, **133**, 161, 656; 1934), with so many of which he has himself been associated. He dealt with the question of the order of the elements, as defined by the atomic number, with the discovery of isotopes, with the arrangement of electrons outside the atom, and with a number of related topics. The lecture sets out very clearly the course of investigation which has provided an explanation of the remarkable generalisation proposed by Mendeléeff in 1869, and also the elucidation of some points of difficulty associated with the Periodic Table before the work of Moseley in 1912–13, which Lord Rutherford described as "an outstanding landmark in the history of our knowledge of the elements".

The Zoological Park of Paris

Many initial difficulties having been overcome, Paris has now a zoological park worthy of the nation, constructed in the Bois de Vincennes upon ground reserved by a law of 1860. The Parc zoologique du Bois de Vincennes, recently inaugurated by the President of the Republic, covers a triangle of about 14 hectares, the longest side bordering Lake Daumesnil. At one of the main entrances rises a hill 68 metres high, on top of which a group of picturesque rocks ingeniously masks two great reservoirs containing the water necessary for the animals. The general idea has been to avoid the stilted cramped zoological garden of the past and to exhibit the animals in open and appropriate spaces, as if in a state of semi-liberty. The photographs illustrating Jean de la Cerisaie's article in *La Nature* of July 1, p. 30, show that the idea has been carried out with skill and artistry. The Zoological Park of Vincennes with its 1,500 animal inmates takes its place worthily with the other modern zoos of Europe.

Hydrogenation of Coal in Australia

INTEREST is rapidly growing in Australia in the possibilities of producing liquid fuel by hydrogenation of coal. The compelling factors are the difficulties placed by foreign oil producing countries in the way of payment by Australia in primary products, considerations of defence and the problem of unemployment in the coal mining areas. The Prime Minister has recently appointed a committee representative of the States, the Department of Defence, Synthetic Coal Oil Products Pty. Ltd., and the Council for Scientific and Industrial Research to report upon the present situation. An immediate question is whether black or brown coal should be taken as raw material and, after that, the terms of reference to the Committee include suitable location for a plant using 1,000 tons of coal per day; costs of production; amount of protection or subsidy or both necessary to maintain operations; and resulting employment, direct and indirect. Presumably Australia will be well advised to await the results of the large-scale operations of Imperial Chemical Industries Ltd., under weigh at Billingham; but the indications are that success in Britain will be followed rapidly by developments on one of the coal fields of the Commonwealth.

Utilisation of Coal

IN the Watt Anniversary Lecture for 1934 of the Greenock Philosophical Society, Prof. W. A. Bone emphasised the continued importance of the coal trade as the mainstay of our national economy. As an unrepentant Free Trader, he pleaded for freer international exchange and held the revival of the coal export trade to be vital to our recovery and to brook no delay. Modern tendencies to economic nationalism, especially in agriculture, were brushed aside. Prof. Bone skilfully outlined modern technical problems. He is not unduly afraid of oil, and gives only a limited approval of hydrogenation for liquid fuel, justifiable probably on strategic grounds only. The use of pulverised coal—freed from ash—appeals to him as a problem to be studied with all the resources at command and he believes that it would be solved if a James Watt or Charles Parsons were to take it in hand. In conjunction with this it is interesting to read an address on "The Utilisation of Coal" given by W. R. Gordon, director of the Coal Utilisation Council, before the Royal Society of Arts (*J. Roy. Soc. Arts*, June 8, 1934). Mr. Gordon outlined the function of the Council set up by the organisation of producers and distributors of coal. The consumer is not represented. Even such large consumers as the public utilities appear to be regarded as competitors, for the Council appears to have a bias for the use of raw coal. In the subsequent discussion, the neglect of the consumers' requirements received adverse comment.

Modern Refrigerated Sea Transport

IN the July number of the monthly journal *Food*, under the above title is a description of the Commonwealth and Dominion liner *Port Chalmers*, the first vessel specially built with gas-tight refrigerated compartments for the transport from New Zealand of chilled beef stored in an atmosphere containing carbon dioxide. The minimum temperature for beef is 29° F. if its qualities are to be preserved. At this temperature, bacterial growth is not entirely stopped and chemical oxidation of the fat continues to take place; consequently there is a time limit of storage in still air of about 35 days. In these circumstances, it has not been possible for beef to be exported from Australia and New Zealand to England. By storage in carbon dioxide, this time is considerably extended, and some experimental shipments having been successful, the *Port Chalmers* was designed with gas-tight welded compartments for the carriage of beef, and she has recently completed her maiden voyage. She is a motor-ship, 486½ ft. long and 11,610 tons dead weight capacity. She has six holds, five of which are insulated, and these can be maintained at various temperatures for chilled beef, frozen mutton, butter, eggs, fruit and other commodities. The refrigerating plant is of the usual type, but in addition there is a large battery of carbon dioxide cylinders from which the gas passes through a British Oxygen Co.'s heater to the chilled beef compartments.

Aluminium in Bridge-work

AN interesting development in bridge-work is described in the *Engineer* of July 27, in which is an account of the reconditioning of the Smithfield Street Bridge which crosses the Monongahela River at Pittsburgh. This bridge forms an important link in communication between Pittsburgh proper and the south side, and is used by trolley-cars, motor vehicles and pedestrians. Built partly of wrought iron and partly of steel and erected in 1882, it has at various times been widened and strengthened, but an examination made in 1926 showed that it was being subjected to excessive stresses. The main features of the bridge include two 'fish belly' trusses of 360-ft. span supporting a floor system which included timber decking 11 in. thick. At first it was considered a new bridge would have to be built, but financial reasons led to the matter being reconsidered, and it was finally decided to replace the whole of the girders, stringers and decking of the floor by aluminium, thus reducing the dead weight on the trusses. The heat-treated aluminium alloy used has an ultimate strength of about 26 tons, a yield point of about 16 tons and an elongation on 2 in. of 20 per cent, and the total saving in weight is more than 1 ton per lineal foot or 751½ tons in all. The cost of reconditioning has been 276,436 dollars, whereas the cost of a new bridge would have been about two million dollars. The bridge as it now stands is estimated to have a life of twenty-five years.

Mining and Fuel Research at Sheffield

THE report on research work carried out in the Departments of Mining and Fuel Technology of the University of Sheffield during 1932–33 (pp. 28. Sheffield: The University, 1933) reveals an extensive range of work bearing on the local industry of coal

getting and utilisation, such as the ventilating and lighting of mines. Of more general interest, a study of the fireproofing of timber showed that ammonium phosphate gave the best results. In fuel technology, the chemistry of coal and coke takes prominence, while combustion in internal combustion engines is under investigation. The prosecution of applied sciences in a university curriculum has received criticism in recent years, but there can be little doubt that the association of teaching with investigation of such technical problems will be of mutual benefit.

Bibliography of Seismology

WE have received the last quarterly part for the year 1933 of the valuable "Bibliography of Seismology" edited by Mr. E. A. Hodgson and issued by the Dominion Observatory, Ottawa. This part completes the tenth volume and contains the titles, and in some cases brief abstracts, of one hundred memoirs on seismology, published with few exceptions during the year 1933. The value of the work is much increased by the addition of two indexes, one of the subjects treated during the past year, the other of the authors, more than one thousand in number, whose works are catalogued in the tenth volume (1929–33).

First Tree Ring Conference

A CONFERENCE on tree ring studies was held on June 11–12, at the Museum of Northern Arizona at Flagstaff, under the chairmanship of Dr. A. E. Douglass of the University of Arizona. Among the problems discussed was the need for a journal in which to publish the original data on which climatological conclusions and prehistoric dates are based. It was, therefore, decided to publish a quarterly journal to be called the *Tree Ring Bulletin*, at a subscription price of 1.50 dollars a year. Dr. A. E. Douglass will be editor-in-chief; Dr. Waldo S. Glock, assistant editor; Dr. Harold S. Colton, managing editor; and Mr. John C. McGregor, assistant managing editor. While the publication will be of immediate interest to archæologists, it will also deal with problems of climatology and other subjects to which tree ring studies are related. Further information can be obtained from Dr. Harold S. Colton, Museum of Northern Arizona, Flagstaff, Arizona.

Association of Special Libraries and Information Bureaux

THE eleventh annual Conference of the Association of Special Libraries and Information Bureaux will be held at Somerville College, Oxford, on September 21–24, under the presidency of Sir Richard Gregory. On September 21, Sir Richard will deliver his presidential address entitled "Science in the Public Press", when the chair will be taken by the past-president, Sir Charles Sherrington. The morning of September 22 will be devoted to a consideration of "Book Selection for Special and General Libraries", when contributions will be made by Mr. A. F. Ridley, "Book Selection for Special Libraries"; Mr. J. E. Walker, "Methods of Selecting Technical and Reference Books for General Libraries"; and Mr. S. G. Wright, "Book Recommendation Methods for University Libraries". Mr. H. V. Horton will also read a paper on "The Use of the Universal Decimal Classification in Photographic Abstracts". The afternoon will be devoted to a consideration of "Some New Libraries", when Mr. Charles Nowell will describe the "Manchester Central Library", and Mr. H. F. Alexander, the "Radcliffe Science Library, Oxford". In the evening, Mr. L. Urwick will read a paper entitled "The Idea of Planning". The morning of September 23 will be devoted to "Planning in its Relation to Information", when the following papers will be read: Mr. K. M. Lindsay, M.P., "Public Efforts at Planning in Great Britain"; and Mr. O. W. Roskill, "The Planning of Industry". In the evening, Mr. L. A. de L. Meredith will discuss "Publicity for Great Britain—Problem of the Supply of Information". In addition to members of the Association, the Conference is open to others who are interested. Further information can be obtained from the Secretary, 16, Russell Square, London, W.C.1.

Announcements

PROF. C. E. WEATHERBURN, professor of mathematics in the University of Western Australia, has been awarded the Hector Medal and Prize by the Royal Society of New Zealand, for his contributions to the subject of differential geometry.

MESSRS. ILFORD LTD. have recently published a booklet entitled "Photography as an Aid to Scientific Work". It is intended as a guide to the best type of photographic material for any given problem, and as such is to be recommended as a very useful book of reference. It is a common difficulty that workers in laboratories cannot obtain a concise and informative summary of the materials and apparatus now available. In this little book, Messrs. Ilford have succeeded in furnishing such a summary relating to the photographic materials which they manufacture.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A lecturer in electrical engineering at Swindon Technical College —The Education Officer, Clarence Street, Swindon (Aug. 18). A director of the University Farm, Cambridge—The Secretary, School of Agriculture, Cambridge (Aug. 29). An engineer and ship surveyor for the Mercantile Marine Branch of the Board of Trade—The Senior Staff Officer, Establishment Department (Mercantile Marine Branch), Board of Trade, Great George Street, London, S.W.1 (Sept. 12). A borough engineer and surveyor for Croydon—The Town Clerk, Town Hall, Croydon (Sept. 13). A botanist at the Royal Botanic Gardens, Kew — The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (Sept. 30). A chief chemist in the Public Health Laboratories, Cairo—The Royal Egyptian Legation, Bute House, 75, South Audley Street, London. An assistant information officer to the International Tin Research and Development Council—The Secretary, Manfield House, 378, Strand, London, W.C.2.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Absorption Spectrum of Vitamin E

IN previous letters to NATURE[1,2] Bowden and Moore described experiments on the absorption spectrum of the unsaponifiable fraction of wheat-germ oil, which were carried out with the view of deciding whether vitamin E possesses a characteristic absorption. It was found that the absorption in the region 3200–2850 A. followed most closely the reputed biological activity. The intensity of absorption was much lower than that found in typical vitamin A concentrates, suggesting either that vitamin E absorbs much less strongly than vitamin A, or that it is present in wheat-germ oil concentrates in relatively small amounts.

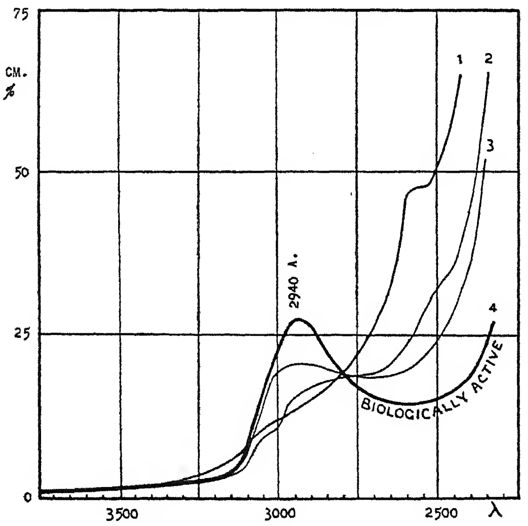

FIG. 1.

On the other hand, Olcott and Matill[3] recently failed to find any characteristic absorption in a vitamin E concentrate prepared from lettuce, and considered it unlikely that the bands examined by Bowden and Moore were connected with biological activity. This was in harmony with the previous experience of Evans and Burr[4] who had been unable to detect characteristic absorption in wheat-germ oil concentrate.

In a continuation of the work, we have prepared a wheat-germ oil concentrate by a simplified technique similar to that described by Evans and Burr[5]. After saponification, the sterol-free fraction of the non-saponifiable residue in which the vitamin is presumed to be present (that is, the fraction which is soluble in both methyl alcohol and light petroleum) was first submitted to chromatographic analysis by adsorption on alumina. The fraction least strongly adsorbed, which showed marked absorption in the region 3200–2850 A., was then sent to Dr. F. H. Carr, of British Drug Houses, Ltd., who kindly undertook to distil the concentrate in the high vacuum apparatus previously used in vitamin A distillations[6]. From 5·5 gm. of concentrate the following fractions were obtained: Fract. 1: b.p. 70°–93° C., 0·7 gm. Fract. 2: 93°–110°, 0·8 gm. Fract. 3: 110°–125°, 0·85 gm. Fract. 4: 125°–130°, 1·8 gm. Residue: b.p., above 130°, 0·35 gm.

The absorption curves in ethyl alcohol given by the above distillates are shown in Fig. 1. The most volatile distillate (fraction 1, curve 1) has a relatively low absorption in the region 3200–2850 A. and a higher absorption in the further ultra-violet, with a subsidiary maximum at 2550 A. The least volatile distillate (fraction 4, curve 4) shows an increased absorption in the suspected region (3200–2850 A.) and develops a well-marked band here with a maximum at 2940 A., $E_1{}^{1\text{ per cent}}_{\text{cm.}} = 27$. The absorption at shorter wave-lengths has decreased. Fractions 2 and 3 appear to be intermediate stages between 1 and 4. At the temperature of liquid air, the band at 2940 A. sharpens up still further, develops a slight structure, and shifts about 30 A. towards longer wave-lengths.

Biological work is still in progress, but we have already been able to detect vitamin E activity in fraction 4, 16 mgm. of which caused a female rat, which had shown characteristic resorption gestation, to produce a litter of eight live young. We have therefore succeeded in detecting a sharp, if relatively weak, absorption band in a vitamin E concentrate of proved biological activity. Whether this band is to be ascribed to the vitamin itself, or merely to accompanying impurities, remains to be decided. It is encouraging, however, that Olcott[7] has recently observed an absorption band in a concentrate prepared from cotton-seed oil in exactly the same position (2940 A.) as that observed in the case of our wheat-germ oil concentrate.

A. J. P. MARTIN.
T. MOORE.
MARION SCHMIDT.

Dunn Nutritional Laboratory,
University of Cambridge.

F. P. BOWDEN.

Laboratory of Physical Chemistry,
University of Cambridge.

[1] Bowden and Moore, NATURE, **131**, 512, April 8, 1933.
[2] Bowden and Moore, *ibid.*, **132**, 204, August 5, 1933.
[3] Olcott and Matill, *J. Biol. Chem.*, **104**, 423; 1934.
[4] Evans and Burr, Memoirs of the University of California, **8**, 144; 1927.
[5] Evans and Burr, *ibid.*, 131.
[6] Carr and Jewell, NATURE, **131**, 92, Jan. 21, 1933.
[7] Olcott, *J. Biol. Chem.*, **105**, proc. lxv; 1934.

Oscillations with Hollow Quartz Cylinders cut along the Optical Axis

A. HUND and R. B. Wright[1] have tried to set into oscillation a quartz cylinder cut along the optical axis, and succeeded only in resorting to circuits which are so regenerative that they are on the verge of self-oscillation.

A careful study of the phenomenon of electrification of a quartz crystal by torsion[2] has led us to work with a co-axial cylindrical shell of quartz, the axis of the cylinder being cut along the optical axis of the crystal. With two electrodes applied to its inner and outer surfaces, such a hollow quartz cylinder constitutes a veritable cylindrical condenser, and can be easily set into oscillation in Pierce's circuit as an ordinary piezo-electric quartz plate.

A hollow quartz cylinder possesses, in general, three fundamental frequencies. Two of them, independent of the length of cylinder, are of ordinary piezo-electric character and correspond respectively to radial (along the wall thickness) and circular (along the wall circumference) vibrations of the hollow cylinder. These modes of vibration are clearly shown by marking out the actual piezo-electric axes by discharge points in glow pattern or under examination with polarised light. The third frequency is probably of torsional oscillation. Further details will be published shortly elsewhere.

NY TSI-ZÉ.
TSIEN LING-CHAO.

Institute of Physics,
National Academy of Peiping,
Peiping, China.
March 28.

[1] A. Hund and R. B. Wright, *J. Res., Bureau of Standards*, 4, 383; 1930. *Proc. Inst. Radio Eng.*, 18, 741; 1930.
[2] Ny Tsi-Zé et Tsien Ling-Chao, *C.R.*, 198, 1395; 1934.

Spontaneous Emission of Neutrons from Radioactive Isotopes

IN confirming the pioneer work of Fermi[1] on radioactivity induced by neutron bombardment, Curie, Joliot and Preiswerk[2] have shown that the radioactive isotopes produced when phosphorus and magnesium are bombarded by neutrons emit: (1) negative electrons, (2) high energy γ-radiation ($\sim 5 \times 10^6$ e.v.), (3) positrons (which they tentatively ascribe to pair formation, this explanation being very doubtful as the high energy limit of these electrons was $\sim 1{\cdot}0 \times 10^6$ e.v.), (4) neutrons. The neutron emission they ascribe to $_{14}Si^{31}$ and $_{13}Al^{28}$, unstable isotopes produced by the initial neutron bombardment.

Goldhaber[3] has shown, however, that these neutrons must get into a state of positive energy by some primary radioactive process and then be immediately emitted. It is the purpose of this note to support Goldhaber's suggestion and to indicate that the results observed arise from the β-ray radioactivity of the two isotopes mentioned.

It has been shown[4,5], from considering the nuclear disintegration experiments which have been performed, that the stable nuclei of the light elements of even atomic number consist of the maximum number of α-particles and neutrons, those of odd atomic number consisting of the maximum number of α-particles, a diplon and a loosely bound neutron. It has also been shown[6] that isotopes of the light elements of even atomic number containing three neutrons and those of the elements of odd atomic number containing a diplon and two neutrons, are β-ray radioactive. In addition it has been demonstrated[7] that β-radioactivity results from the formation of electron pairs within the nucleus with the production of a proton as the positron is captured by a neutron, the negative electron being emitted to form the disintegrating β-ray.

Applying these views, the β-radioactivity of $_{13}Al^{28}$ $(6\alpha + D + 2n)$ results in the formation of a new α-particle in the nucleus by the union of the diplon and the new diplon formed when the positron of the pair unites with the neutrons. This α-particle is formed in a state of excess energy as shown by Oliphant, Harteck and Rutherford[8]. It may then transfer to the normal state and be bound within the nucleus forming $_{14}Si^{28}$ (7α), with the emission of high energy γ-radiation. Or it may emit a neutron leaving $_2He^3$ within the new nucleus $_{14}Si^{27}$ $(6\alpha + D + p)$ and this 'radiosilicon' containing a 'free' nuclear proton[9] emits positive electrons transmuting to $_{13}Al^{27}$.

Similarly the β-ray emission of $_{14}Si^{31}$ results in the formation of a diplon within the nucleus, mass defect energy 5×10^6 e.v. being released. This may be emitted in the form of γ-radiation when the stable $_{15}P^{31}$ is formed, or the loosely bound neutron may be emitted immediately carrying the excess energy. As a result, 'radiophosphorus' $_{15}P^{30}$ is formed which spontaneously emits positrons transmuting to $_{14}Si^{30}$.

Thus, on the view of nuclear structure adopted, the γ-radiation of high energy, the neutron and the positron emission all result from the β-ray radioactivity of the unstable nuclei produced. It is to be noticed that spontaneous emission of protons is possible from $_{13}Al^{28}$.

H. J. WALKE.

Department of Physics,
Washington Singer Laboratories,
University College, Exeter.

[1] Fermi, *Ricerca Scientifica*, 1, 283, 330; 1934.
[2] Curie, Joliot and Preiswerk, *C.R.*, 198, 2089; 1934.
[3] Goldhaber, NATURE, 134, 25, July 7, 1934.
[4] Walke, *Phil. Mag.*, 17, 793; 1934.
[5] Walke, *Phil. Mag.*, 18, 129; 1934.
[6] Newman and Walke, NATURE, 134, 64, July 14, 1934.
[7] Walke, *Phil. Mag.*, 17, 1176; 1934.
[8] Oliphant, Harteck and Rutherford, NATURE, 133, 481, Mar. 31, 1934.
[9] Walke, *Phil. Mag.*, 18, 154; 1934.

The Sycamore Maple in A.D. 1300

IN his description of the carvings of the sycamore on the shrine of St. Frideswyde in the Oxford Cathedral, Dr. Burtt Davy[1] gives a list of ten species of plants that were in all probability growing in or near Oxford about A.D. 1300, when the shrine was being carved. It is only fair to note that the remarkable truth to Nature of the carvings of the fruits and leaves of this tree, and of the nine other species of plants mentioned by Dr. Davy, had already been recognised by Mr. S. A. Warner, with the addition of two more, the water crowfoot, *Ranunculus aquatilis*, and the hogweed, *Heracleum sphondylium*, to the list which, with three illustrations, is printed in my "Early Science in Oxford", vol. 3, p. 198.

R. T. GUNTHER.

The Old Ashmolean,
Oxford.
July 14.

[1] NATURE, 134, 61, July 14, 1934.

THE three illustrations referred to by Dr. Gunther do not include *Acer pseudoplatanus*, nor do his published notes make any reference to the fact that the carving is the earliest known record of the occurrence of the sycamore maple in Britain, antedating previous records by a quarter of a century. I did not mention the hogweed and water crowfoot, as their identification seemed less certain than that of the other species.

I owe Dr. Gunther an apology for not having mentioned the notes and reproductions referred to, which—I regret to say—I had not seen.

J. BURTT DAVY.

Imperial Forestry Institute,
Oxford.
July 21.

Reflecting Power of Aluminised Surfaces

DURING the course of some recent work on the reflecting powers of certain metallic substances in the ultra-violet part of the spectrum, I have had the opportunity of testing the behaviour of aluminium (deposited on to a glass surface by the new evaporation method) and it was thought that the results obtained would be of sufficient interest to justify this note. The accompanying table gives the values

λ	Proportion reflected	λ	Proportion reflected
3610 A.	0·84	2265 A.	0·86
3404	0·83	2196	0·86
3261	0·91	2144	0·84
2981	0·90	1990	0·87
2749	0·90	1936	0·87
2573	0·89	1863	0·70
2313	0·91		

for radiation of normal incidence, and the spectrograms (Fig. 1) show the relative 'density' of the lines (*a*) when employing the spark alone, and (*b*) when the reflecting surface was used. From these it will be noticed how regular is the reflection throughout the entire ultra-violet spectrum, and that the reflecting power is unusually high for a metal even down to $\lambda = 1863$ A.

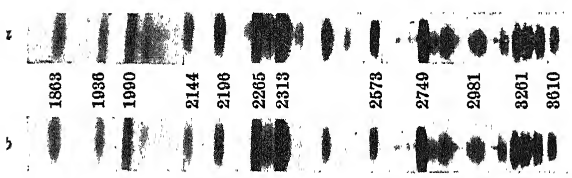

FIG. 1.

I wish to express my thanks for the co-operation of Mr. C. H. Walker of Messrs. Metropolitan-Vickers Electrical Co., Ltd., in producing the aluminised surface for the tests.

B. K. JOHNSON.

Royal College of Science,
South Kensington,
S.W.7.
June 29.

Asymptotic Developments of Periodic Functions related to Periodical Physical Phenomena

IT is interesting to note that certain well-known results in electromagnetic radiation and wave mechanics may be deduced from general considerations regarding the nature of functions representing the solutions of differential equations of the field concerned.

Take, for example, the case of a field of electrons which may be regarded as singularities of the function representing the field. Suppose, as Ferrier has done, that $F(u)$ is a certain function (well determined) of relative velocities of any two electrons. If the movements are vibratory, $F(u)$ will be a periodic function with a maximum and a minimum. Such a function may be asymptotically developed. With given singularities, a differential equation may be easily found such that

$$W = H\nu$$

where W is the Einsteinian energy of the system and H is a function of Planck's constant h.

Again, developing asymptotically the solution ψ of Schrödinger's wave equation in the form

$$\psi \sim e^{\lambda s} - \left(v_0 + \frac{v_1}{\lambda} + \ . \ . \ . \right),$$

Birkhoff[1] has shown that an invariantive relation for arbitrary linear transformations of the field is obtained. This result is obtainable from the linearity of the developments. Again, the wave equation

$$\nabla^2 u = c^{-2}\, \partial^2 u / \partial t^2$$

may be treated with the help of asymptotic developments of certain curls of the field. Recently, René Reulos[2] has obtained a general solution in a remarkably simple form by considering asymptotic developments. The solution replaces the ordinary method of retarded potential solutions although the solutions of Reulos approach in the limit the classical solutions in the case of electrons of constant velocity.

The peculiarity of all these solutions lies in the fact that no assumption need be made with regard to the structure of the electrons or protons or of the field concerned, except that there are certain singularities of fields representable by poles of functions regulating the general field.

In this connexion, a remark of Reulos's must not be overlooked. He finds that his solution of the wave equation differs from the classical solution in the case of accelerated electrons. The reason for this appears to me to lie in the fact that in an asymptotic development the convergence is sometimes restricted, and hence the result cannot be identical with that derived from a finite series.

S. C. BAGCHI.

Mathematical Society,
University College of Science,
92, Upper Circular Road,
Calcutta.
June 6.

[1] *Proc. Nat. Acad. Sci.*, March 1933.
[2] *C.R.*, 1015, March 12, 1934.

Shear Waves through the Earth's Core

IN 1914, Gutenberg[1] published an analysis of earthquake waves arriving at great distances, in which he inferred the existence of a major surface of discontinuity at a depth of about 1,800 miles, bounding a central core within the earth. His predictions regarding the characteristics of compressional (P) waves transmitted through this core have been abundantly verified. But until recently, no signs have been forthcoming of the existence of distortional (S) waves that had penetrated this central mass. The conclusion has thus gradually come to be accepted that the core is in a fluid or semi-fluid state, and is thus incapable of transmitting shear waves that reach its boundary. Two branches to both types of core waves were indicated by Gutenberg's theory, and have been designated by Macelwane P_1 and P_2', S_1' and S_2' respectively.

Recently Macelwane[2] and Imamura[3] have published fragmentary evidence supporting the occurrence of shear waves transmitted through the core and conforming to Gutenberg's predictions. But the former expressed himself as dubious of the adequacy of the evidence; and the latter can scarcely be credited with settling the controversy on the evidence of a single identification—apart from the fact that the identification is open to criticism.

In studying the European records of the 1929 Buller (N.Z.) earthquake, I have found unmistakable signs of S_1' at 16 stations between 145° and 175° from the epicentre. At Abisco (149·9°) and Pulkovo (150·6°), large amplitudes appear. Later, before 156°, signs of the second branch emerge, and reach prominence at Vienna (162·0°). This movement has been traced at 19 stations within 180°, and at 7 stations beyond. In most cases, the phase closely following, *PPS*, is also distinguishable and a separate curve has been plotted for it.

The travel-times for the shear waves agree with Gutenberg's predictions to within 10 seconds throughout most of the range; and point undoubtedly to the possibility of these waves having arrived at the antipodes by way of the core. Comparing these times for the two branches with the corresponding travel-times for the two branches of P', we obtain ratios, for 165°, of 1·80 and 1·81, which agree remarkably well with the values for the velocity ratio (1·79–1·84) for P and S waves which have travelled wholly through the extra-nuclear layer. The rigidity of the core thus seems to be definitely established.

It seems appropriate at this juncture to revise the notation for these phases. Recently the Seismological Committee of the British Association has approved of the use of K instead of ${}_cP_c$ for compressional waves through the core; and '*SKS*' has thus received official sanction. P' might similarly be written *PKP*. The objection to the dashed notation is that it has received wide support to indicate phases registered beyond 180°. The desirability of using it in this connexion for the sheer waves beyond the antipodes emerges from what has been said above. In order to maintain a uniform notation, it is now suggested to employ Z for shear waves through the core; so that S_1' becomes *SZS*; and a square bracket or other similar device would indicate the later branch of each movement. Thus $P_2'=[PKP]$, $S_2'=[SZS]$ within 180° and $[SZS]'$ beyond.

L. BASTINGS.

Dominion Observatory,
Wellington,
New Zealand.
May 7.

1 Über Erdbebenwellen VIIA. *Nachr. Ges. Wess. Gott.*, 125; 1914.
2 *Gerlands Bei. Geophys.*, **28**, 165; 1930.
3 *Proc. Imp. Acad. Tokyo*, **8**, 354; 1932.

Structure of the Nitro Group

THE usual formula given to the nitro group is $-N{\begin{smallmatrix} = O \\ \searrow O\end{smallmatrix}}$, containing a co-ordinate link[1], and it is supported by the parachor evidence[2]. On account of this dissymmetry, both the compounds 1-4-dinitrobenzene and 1-3-5-trinitrobenzene should possess finite electric dipole moments. Also studies in benzene[3] and in naphthalene[4] have resulted in moments of 0·6 and 0·8 Debye units being ascribed to the di- and tri-substituted compounds respectively.

The electric moment μ is calculated from ${}_\infty P_2 - {}_E P_2 = 4\pi N\mu^2/9kT$ with the usual notation, the differences ${}_\infty P_2 - {}_E P_2$ having been found to be finite in the solvents used, and in the case of trinitrobenzene in benzene amounting to 14 c.c. The problem we have is correctly to assign these finite differences. There are three possibilities:

(1) The molecules have permanent electric moments.

(2) The differences ${}_\infty P_2 - {}_E P_2$ are real, but are to be ascribed to atom polarisation, this being the opinion of Smyth[5].

(3) The last possibility, which it is hoped has now been proved, is that the differences are spurious, being due to specific solvent effects of benzene and naphthalene on the dissolved nitro bodies.

Now compounds of benzene and naphthalene with these nitro bodies are known[4,6], and if they exist in solution the usual dipole procedure will become upset, and the results will be of doubtful significance. That this has occurred has now been shown by measuring ${}_\infty P_2 - {}_E P_2$ for both 1-4-dinitrobenzene and 1-3-5-trinitrobenzene in the polar solvent chloroform, and in each case a zero value was obtained. The suitability of chloroform as a solvent for measuring the dipole moments of non-polar molecules was demonstrated by showing that ${}_\infty P_2 - {}_E P_2$ was zero for benzene in chloroform.

Evidently, then, both the nitro compounds are non-polar, the nitro group is symmetrical, and so, following the wave mechanical chemist, we say a resonance exists between $-N{\begin{smallmatrix} = O \\ \searrow O\end{smallmatrix}}$ and $-N{\begin{smallmatrix} \nearrow O \\ = O\end{smallmatrix}}$.

H. O. JENKINS.

Jesus College,
Oxford.
July 5.

1 Sidgwick, "Electronic Theory of Valency", p. 65.
2 Sugden, "The Parachor and Valency", p. 118.
3 Parts, *Z. Phys. Chem.*, 4 B, 227; 1929. Tiganik, *ibid.*, 13 B, 425; 1931. Lutgert, *ibid.*, 14 B, 31; 1931.
4 Brieglieb and Kambeitz, *Naturwiss.*, 105; 1934.
5 "Dielectric Constant and Molecular Structure".
6 D. L. Hammick, Hills and Howard, *J. Chem. Soc.*, 1530; 1932.

Synthesis in the Œstrin Group

THE chemistry of α-folliculin (α-œstrone) is now fairly well understood, through the combined researches of the British and the German schools. It will no doubt be highly interesting to institute a series of synthetical investigations in this group of substances. Work in this direction has been in progress in this laboratory for some time past, and the opportunity is taken to place on record a brief outline of the method that is being pursued.

In the first instance, β-1-naphthylethyl bromide was condensed with the sodio-derivative of methyl β-ketoadipate (b.p. 127–128°4 mm.), which was prepared in quantity by the usual methods. The resulting ketoester smoothly underwent phenanthrene cyclisation in presence of sulphuric acid giving 2-carboxy-3 : 4-dihydrophenanthrene-1-propionic acid (m.p. 226–227°, once crystallised). The latter on distillation with acetic anhydride gave a beautifully crystalline substance (m.p. 210°) having the composition $C_{17}H_{14}O$. The œstrus-producing activity of the final product, which is being studied, is likely to yield interesting results. Further work along this line, starting from initial materials containing appropriate substituents, are actively in progress with the view of synthesising α-œstrone and other related ketones.

J. C. BARDHAN.

University College of Science,
92, Upper Circular Road, Calcutta.
July 9.

Micro-organisms and Plant Growth

THE correspondence (references in the letter by B. Viswa Nath and M. Suryanarayana[1]) between one Finnish and two Indian groups of workers, on the effect of organic substances upon plant growth, is accenting the need for collaboration between scientific workers. It is indeed curious to note how in this field of plant accessory substances, as in the field of work upon the effects of plants grown in association, workers have remained in ignorance of prior publications even within one country. I make no claim to priority, but, being fortunate in having access to the library of Rothamsted Experimental Station, I am familiar with the papers of most of the workers in both these fields.

A review entitled "The Derivation of the Nitrogen of Crop Plants, with Special Reference to Associated Growth" will appear in *Biological Reviews* in October. A section on "Accessory Factors and the Growth of Plants" does not pretend to be exhaustive, but contains references to work by the schools of Viswa Nath, Virtanen and others.

I think it important to point out that vitamins produced by plants, and required by animals, need not be identical with those accessory substances which may be required by plants for their own growth. This possible distinction does not appear to have been appreciated by Virtanen[2] and was tentatively rejected by Rowlands and Wilkinson[3]. It seems likely, as Indian workers have suggested, that the accessory substances required by plants are produced by micro-organisms with or without the aid of animals and animal secretions (Isaachsen[4]). A scheme has been put forward in my review, wherein the word 'phytamin' has been proposed for such true plant growth organic accessory substances.

HUGH NICOL.

Rothamsted Experimental Station,
Harpenden, Herts.
July 7.

[1] B. Viswa Nath and M. Suryanarayana, NATURE, 134, 27, July 7, 1934.
[2] A. I. Virtanen, "Ueber die Stickstoffernährung der Pflanzen". *Ann. Acad. Sci. Fenn.*, Ser. A, 36, No. 12. Helsinki, 1933.
[3] M. J. Rowlands and Barbara Wilkinson, *Biochem. J.*, 24, 199; 1930.
[4] H. I. Isaachsen, "Effekten av husdyrgjødsel kontra kunstgjødsel". *Tidsskr. norske Landbr.*, 225; 1933. Abstract in *Nordisk Jordbrugsforskn.*, 67; 1934.

IN connexion with the correspondence in NATURE[1] on the effect of yeast extract on plant growth, writers upon this subject may be interested to know that yeast has for a long time been recognised as a fertiliser on the Keuper Marls around Burton-on-Trent. Thirty years ago it was a very common dressing on grassland, giving an effect resembling that of nitrogenous manure.

Credit for the discovery seems to belong to a certain farmer who carted 'barm' for his stock and then washed out his cart beside a pond in one of his pastures.

W. B. MERCER.

Cheshire School of Agriculture,
Reaseheath,
Nantwich.
July 7.

[1] NATURE, 134, 27, July 7, 1934.

Respiratory System of the White-Fly, *Dialeurodes dissimilis* Quaint. and Baker (Homoptera, Aleurodidæ)

ACCOUNTS of the post-embryonic development of the tracheal system of any insect are extremely meagre. The development of the breathing folds (organs peculiar to the Aleurodidæ and some of the Coccidæ) has never been studied completely in any white-fly. I have carried out a study of the development of the respiratory system of the nymphal stages of the white-fly *Dialeurodes dissimilis* Quaint. and Baker, which occurs on *Ixora parviflora* in India, without doing any apparent damage to the host plant. Some extremely interesting and wholely unexpected results have thus come to light. The only previous account of the development of the tracheal system of a white-fly is that of Woodworth[1], which, however, is inaccurate in many respects.

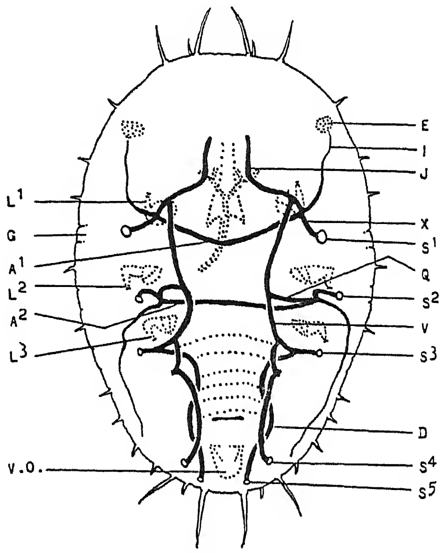

FIG. 1. First instar nymph showing tracheal system seen from the ventral side. Camera lucida drawing. × 185.—A[1], anterior-dorsal commissural trachea; A[2], posterior-dorsal commissural trachea; D, dorsal-longitudinal tracheal trunk; E, eye; G, thoracic breathing fold; I, ocularo-breathing fold trachea; J, oral trachea; L[1], L[2], L[3], first, second and third legs; Q, palisade trachea; S[1], S[2], S[3], S[4], first, second, third and fourth spiracles; S[5], probable fifth spiracle; V, ventral-longitudinal tracheal trunk; V.O., vasiform orifice; X, spiracular trachea.

The number of spiracles in *Dialeurodes dissimilis* in all the nymphal instars is four (probably five in the first instar); they lie on the ventral surface of the nymphs, but their exact position varies in the different instars. The third pair of spiracles is replaced by an entirely *new* one in the third instar. The spiracles, as studied in the pupa, are of a simple type, and have no closing mechanism.

The tracheal system consists fundamentally of paired dorsal- and ventral-longitudinal trunks, two dorsal commissural tracheæ, the spiracular and palisade tracheæ and the various branches of the main system, the most important ones being those belonging to the ventral-longitudinal tracheal trunks and are the following: ocularo-breathing fold trachea dividing into an ocular branch and a breathing fold branch; oral trachea; mycetomal trachea; and several other smaller branches. Growth of the

tracheal system consists, on the whole, of arborescent branching of the system present in the first instar, but there also occur some remarkable changes of atrophy; for example, the dorsal-longitudinal tracheal trunk, which at first does not open directly into the ventral-longitudinal tracheal trunk, finally does so, and its end portions atrophy. The final number of the tracheal branches (in the pupa) is constant and is 156. There is a gradual shifting backwards of the tracheal system with reference to the body segments. Some of the tracheal branches in the pupa which are apparently homologous actually develop hetrochronously.

The breathing folds are just visible in the first instar (except the posterior one which first makes its appearance in the third instar); their growth consists in the deepening of the furrows, the development of papillæ on the roof and the formation of elaborate marginal openings.

The detailed results of this investigation will appear elsewhere.

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University of Lucknow and
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[1] *Canadian Entomologist*, **33**; 1901.

The Government and Inland Water Survey

I AM glad to see that the observations expressed in the leading article in NATURE of August 4 represent so clearly and unmistakably the views of the British Association Research Committee, of which I am chairman.

It may be added that on the occasion of the deputation to Sir Hilton Young, I directed his attention to the fact that our Committee comprises not only competent engineers and scientific experts of independent standing, but also technical representatives of the various Government departments interested (including the Ministry of Health), these gentlemen, although not officially nominated, being co-opted with the cognisance and approval of the departments concerned.

It is to be hoped, when the suggestions made by the deputation are receiving "the most careful consideration of the Government" promised by the Minister of Health, that the advice tendered by these technical officers will not be ignored, and that the Government will consequently be able to view the matter in its proper light and agree to action being taken along the lines indicated, without undue delay.

H. P. DOUGLAS.

Aug. 4.

Discovery of a Fossil Elephant in Palestine

QUITE recently a discovery of remains of an extinct elephant has been made in Palestine. This is the first time that such remains have been discovered there, nor have they yet occurred in Syria, and it will be of interest to see if this find has any connexion with the faunas of so-called African type which have been found in several Palestinian caves associated with a Mousterian culture and human remains.

The newly found specimens were obtained in digging a well in a garden at Bethlehem, but unfortunately the value of the remains was not at first recognised, and thus, except for a section of tusk 8 cm. in length, the bones and teeth are in a very fragmentary condition. During a recent stay in Jerusalem, I was able, with the co-operation of the Museum authorities, to collect a few more fragments from the material dug out of the well. All the specimens have now been sent by the Department of Antiquities of Palestine to the British Museum (Natural History) for study. It is hoped that a detailed description of these remains will shortly be published, and that it may be possible for further excavations to be made at this locality. The deposit in which these elephant remains occur is doubtless Pleistocene, but information as to the precise age of the beds is still needed.

DOROTHEA M. A. BATE.

Department of Geology,
British Museum (Natural History).

Aug. 3.

Luminous Night Clouds

ON the night of June 30–July 1 large masses of night clouds were seen over southern Norway, travelling with great velocity from east to west. Three of my aurora stations, Oslo, Kongsberg and Toemte, were in action, and a series of simultaneous photographs were taken from all three stations. By inspecting the plates, one gets the impression that the height was of the same order, about 80 km., as in 1932, but details can only be given when the plates are measured and calculated.

It would be interesting to know if the clouds have been seen in other countries. Probably they will appear again and a look-out for them is very desirable.

On account of their great height, they may perhaps disturb radio propagations, and observations in this respect would be very interesting.

CARL STÖRMER.

Dröbak, near Oslo.

July 10.

Hostility of Starlings to Swallows

HAS any special enmity of starlings against swallows been observed? If so, what is the reason suggested for it?

In my garden is a little lake, a shallow reach of which is largely used as a bath and for drinking by a great variety of birds, including starlings. A few swallows (*Hirundo rustica*) also skim the lake frequently for insects; and occasionally alight each day on one or other of the stones on the bank preliminary to drinking. Whenever a swallow thus alights whilst any starlings are near, one or more of the latter immediately rush viciously at the swallow, trying to peck it and driving it off. On the other hand, none of the many other frequenting birds, and not even the pugnacious blackbirds and sparrows, exhibit any hostility to these inoffensive, graceful visitors. Nor do the starlings, so quarrelsome amongst themselves, habitually drive off other birds than the swallows, but feed amongst many of them, although the latter are searching for the same food as themselves, worms, insects and beetles. Hence the motive of this hostility does not appear to be based on the food problem, or envy at the superior agility of the swallow in catching insect food on the wing.

L. A. WADDELL.

Ardsloy, Craigmore,
Rothesay.

July 9.

Research Items

Head-Hunters of New Guinea. Dr. H. H. Sharp describes in *Man* of July the Gumakari people of the Suki Creek, New Guinea, in whose lives head-hunting plays an important part, and is in fact a religion. The Gumakari people inhabit villages in the lagoons and marshes drained by the creek to which the name Suki, a foreign name, has been applied. Dancing, head-hunting and hunting are their principal occupations. The chieftainship is hereditary, and exists in a virile form. The chief controls the cultural life of the people, and his power is remarkable. When the people go head-hunting they are accompanied by the women, who go to make sago and keep the party in food; but in a recent raid the women are said to have killed some Weredai who escaped into the water. The reason for a recent raid against the Weredai is said to have been that there were five widows in the village who could not have sexual intercourse or eat the flesh of kangaroos until heads had been taken. Since the raid the women have joined certain men of the tribe, but these were not men who were necessarily the 'big men' of the raid. The Gumakari are said normally to have taken their heads from a tribe of nomads, who live in a tract of bamboo-forest land on the banks of the Fly River. When a head is taken the victim is killed, if possible, by blows on the body; in some instances, the head is removed while the victim is alive. Old experienced hunters never break a head. The heads are carried back in a natural state, and after a ceremonial dance are preserved, the skin being retained over the skull. After two or three years, when they cease to be in good condition, they are buried without ceremony.

Studies on Diphtheria and Diphtheria Immunity. A remarkable epidemiological study, extending over ten years, of the occurrence of diphtheria and of diphtheria bacilli carriers, and of the development of immunity to diphtheria in a relatively isolated community with a population of approximately 1,000 susceptible individuals, is brought to a close by the issue of a report by Surg.-Capts. Dudley and May and Surg.-Com. O'Flynn ("Active Immunization against Diphtheria". *Spec. Rep. Series*, No. 195. Med. Research Council. H.M. Stationery Office. 3*s*. net). In 1921, permission was obtained to apply the Schick test of diphtheria susceptibility and immunity to the inmates of the Greenwich Hospital School; and since then up to the removal of the School from London last year, it has been possible to watch the distribution and development of diphtheria immunity and the occurrence of diphtheria bacilli carriers in this institution. In 1928, inoculation against diphtheria was introduced, allowing a comparison to be made between natural immunity acquired by a community in which diphtheria was endemic, and immunity artificially induced by inoculation. Prior to inoculation, the School was subject to an intense degree of diphtheria infection, for the average number of cases of diphtheria notified per annum was 45. In these circumstances, latent immunisation proceeds rapidly, so that it is calculated that three years' residence in the School produced an immunisation as effective as the usual prophylactic procedures, but with the danger that for every three or four latent immunisations, one case of diphtheria occurred. On the other hand, it was found that three doses of a diphtheria toxoid prophylactic produced in 3 months as high a degree of immunity as the 3 years' residence, and with the added advantage of the almost complete disappearance of clinically recognisable diphtheria. No doubt the conditions at the Greenwich School were exceptional, and two plates, one of the boys at dinner, and the other of the sleeping quarters, illustrate the overcrowding that existed.

Bionomics of Two Estuarine Crabs. Under this title (*Proc. Zool. Soc. Lond.*, Part 4; 1933) Dr. Sunder Lal Hora describes the habits of the two Indian crabs, *Varuna literata*, Fabr., and *Sesarma tetragonum*, Fabr. The former is the commonest species of crab in the deltaic region of the Ganges. At Uttarbhag, 23 miles from Calcutta, it lives in the mud of the low-lying land in the neighbourhood of vast stretches of rice fields. During the wet season there is a good deal of brackish water, and in the dry season the earth becomes cracked into slabs which become detachable from the damp mud below, and the crabs live in these cracks. Later, when nearly all was dry, they made oblique burrows a couple of feet or so down and were found near the water-level. *Sesarma tetragonum* lives on the high banks of the water channels, digging a burrow almost vertically to the depth of the subsoil water. One was dug open and the water struck at about 5 ft., and there was about 8 in. of water in the burrow. The crabs were found above. The salinity of the water in the burrow was much less than in the adjoining channel. Neither of the crabs becomes completely dormant even at the height of the dry season when there is no food. Both have become almost terrestrial, although dependent on some moisture; they appear to want a certain amount of atmospheric air. They are thus not affected by changes of salinity so much as the truly aquatic species. The volume of the gills seems to be considerably reduced in *Sesarma*, and the gill chamber large, so that there are cavities for storing air. In *Varuna* the gill chambers are filled by the gills and no accessory devices were noticed. The author thinks it probable that the gills themselves have become specially modified for aerial respiration.

Classification of Nematodes. I. N. Filipjev (*Smiths. Misc. Coll.*, 89; 1934) considers that, in various morphological features and in their physiology, free-living nematodes, and especially the marine forms, are primitive. He agrees with Bastian that the organisation of the free-living forms "as a whole differs in no obvious or important manner from that of their parasitic kindred", and hence the group cannot be divided into two—one for free-living and the other for parasitic members. The author proposes a classification into eleven orders, and provides a key thereto and keys to the families included in six of these orders He points out that the emphasis on parasitic forms is merely a result of the historical sequence in the study of nematodes, for systematic studies of parasitic nematodes have been carried out by numerous workers since they were initiated by Rudolphi in 1819, whereas the study of free-living nematodes began with Bastian in 1865, and only during the last fifteen years has there been a notable increase in the workers on them. A table shows that the number of species described to the end of

1930 includes 2,165 free-living and 2,436 parasitic—the latter figure being regarded as subject to correction. Among collections of marine free-living nematodes a large proportion prove to be new species, and the author gives his opinion that the marine species probably exceed in number both parasitic and fresh-water species together. Eight plates with seventy figures serve to illustrate the principal characters of five of the orders.

Diptera of Patagonia and South Chile. Two new fascicles of a work on the Diptera of Patagonia and South Chile, in course of publication by the British Museum (Natural History), have appeared. They deal with a number of families of the Acalyptrata together with the families Syrphidæ and Conopidæ. Various new genera and a number of new species are here described for the first time. The descriptions, it may be added, are accompanied by admirably clear text-figures and plates. The Acalyptrata are dealt with by Mr. J. R. Malloch, who is also jointly responsible with Miss D. Aubertin for the Conopidæ, while the Syrphidæ are described by Mr. R. C. Shannon and Miss D. Aubertin.

The Periodic Table in Plant Physiology. The late Prof. R. W. Thatcher has proposed a scheme (*Science*, May 25, 1934) for the classification of the chemical elements on the basis of their functions in plant nutrition, attempting to correlate these with the positions of the elements in the periodic table. The scheme rests on the observation that elements which are closely associated in the periodic table may be grouped together on the basis of physiological function in the plant. The chief value of the proposed scheme is that it will serve to remind plant physiologists of the existence of the periodic classification of the elements, and thus render their nutrition data more intelligible, but carried to its logical conclusion it will surely result merely in a restatement of the periodic law, that the properties of the elements (*including their biological properties*) are a periodic function of the atomic weights. It follows therefore that elements which in virtue of their similar fundamental properties are situated in adjacent places in the periodic table must necessarily serve closely similar functions in the plant. The observation that in certain cases potassium is absorbed readily by plant cells, whilst the closely related element, sodium, is excluded, provides an apparent exception, but in the ultimate analysis this difference in behaviour must be due to some difference in the specific properties of the elements relative to the living cell. That the elements concerned in nutrition are confined to the first half of the periodic table may be explained on general permeability grounds, the heavier elements being excluded. Information regarding the precise functions of the elements in nutrition is at most fragmentary except in the case of elements like carbon, nitrogen, oxygen, sulphur and phosphorus which enter into the actual structure of the cell, and do so presumably because of their peculiar valence properties and capacity for entering into large molecular complexes. In this connexion, it is significant that carbon, nitrogen and oxygen, the chief components of protein complexes, have closely similar atomic diameters.

Chromosomes of Cotton Hybrids. A cytological study of certain hybrids between Asiatic and New World cottons has been made by Dr. A. Skovsted (*J. Genet.*, 28, No. 3). The former have $2n = 26$ chromosomes, while most species of New World cottons have $2n = 52$. One of his hybrids had 39 chromosomes and the other 52. It is inferred that a diploid egg of Asiatic cotton functioned to produce the latter. From measurements of the chromosomes, Svoksted concludes that those of the Asiatic species are of equal size and large, while the New World cottons have chromosomes half of which are large and half smaller. In hybrids with 39 chromosomes, previous workers have found 13 bivalents and 13 univalents at meiosis. He finds many irregularities, and that groupings of 3, 4, 5 and 6 chromosomes are frequently present. The nuclei may also fuse, producing gametes with the unreduced number of chromosomes. At least 13 univalents were present in both hybiids. The conclusion is drawn that the chromosomes of Asiatic cotton are homologous with half those of the New World cottons, the other half forming the univalents. The New World cottons are therefore regarded as amphidiploid species, formed by chromosome doubling in a hybrid between an Asiatic species with 13 large (haploid) chromosomes and some unknown species having 13 small chromosomes. If this difference in the size of the chromosomes is confirmed, it should be of considerable value in helping to trace the chequered history of the cultivated cottons.

Continental Undulations of the Geoid. This is the title of a memoir (in English) by R. A. Hirvonen in No. 19, *Veröff. Finnischen Geodätischen Institutes, Helsinki*, 1934. It opens with an account of the theory connecting the form of the geoid with the variation of gravity, the work of Stokes, Helmert, Pizzetti and Hopfner being specially considered. The available gravity data are then applied to determine the order of magnitude of the warping of the geoid, and it is found that this does not generally exceed 100 metres and is on an average $\pm$ 50 m., contrary to the conclusion of Hopfner and Ackerl, whose estimate was $\pm$ 1,000 m. The ellipticity of the equator is considered well-established, the longer axis being somewhat westward of the Greenwich meridian.

The Beilby Layer. G. I. Finch, A. G. Quarrell and J. S. Roebuck (*Proc. Roy. Soc.*, A, July) have obtained very interesting results which seem conclusively to demonstrate the existence of a flowed amorphous surface layer on polished metals. In their experiments, a metal layer was evaporated on to a metal surface, while the latter was being examined in an electron diffraction camera with fluorescent screen. When zinc was deposited on an etched copper surface, the normal zinc diffraction rings appeared and remained unchanged for a long time. On a polished surface, however, the zinc rings flashed up and then disappeared in the course of a few seconds. Photographs show that the rings disappear without appreciable broadening. These experiments add very strongly to the evidence for the Beilby layer of flowed amorphous metal on polished surfaces. It has been known for some time that a polished surface gives rise to a random scattering of electrons, but some uncertainty still existed about the interpretation of this result. In the present work, the zinc layer on polished copper was not readily removed by rubbing, and the zinc crystals appear to dissolve in the surface layer. Similar results were obtained with several other pairs of metals.

International Congress of Anthropological and Ethnological Sciences

THE first session of the recently constituted International Congress of Anthropological and Ethnological Sciences was held under the patronage of H.R.H. the Duke of York and the presidency of the Earl of Onslow at University College, London, on July 30–August 4. Owing to the regretted absence of the Duke of York through illness, the Congress was declared open on July 30 by H.R.H. Prince George.

The members of the Congress numbered more than eleven hundred, of whom about a thousand were present, including delegates from forty-two foreign countries and British dependencies, and representatives of a large number of universities, academies and other learned bodies.

The work of the Congress was distributed among eleven sections and more than four hundred communications were presented. The sectional presidents were : *Aa* (Anatomy and Physical Anthropology) Sir Grafton Elliot Smith (London) ; *Ab* (Anthropometry) Prof. H. J. Fleure (Manchester) ; *B* (Psychology) Prof. F. C. Bartlett (Cambridge) ; *C* (Demography) Prof. C. B. Fawcett (London) ; *Da* (Ethnography, general) Dr. A. C. Haddon (Cambridge) ; *Db* (Ethnography of Africa) Rev. E. W. Smith (London) ; *Dc* (Ethnography of America) T. A. Joyce (London) ; *E* (Technology) H. Balfour (Oxford) ; *F* (Sociology) Prof. C. G. Seligman (London) ; *G* (Religions) Prof. E. O. James (Leeds) ; *H* (Linguistics and Writing) Dr. Alan H. Gardiner (London).

In addition to the communications presented in the sections, addresses to the Congress as a whole were delivered by Prof. T. C. Hodson on "Certain Aspects of the Indian Census, 1931", on August 1 ; Dr. R. R. Marett on "Movements and Tendencies in the Anthropological and Ethnological Sciences", on August 2 ; and by Prof. J. B. S. Haldane on "Anthropology and Human Biology", on August 3. In addition, the Royal Anthropological Institute met with the Congress for the delivery of the Huxley Memorial Lecture by Sir Aurel Stein on "The Prehistory of the Indo-Iranian Borderlands as illustrated by Recent Exploration", on July 31.

Any attempt to give even a list of the communications within a reasonable limit of space is an impossibility, nor can attention be directed to all the papers which dealt with topics of outstanding interest. The selection of questions to which discussion was directed in the preliminary outline of the programme issued with invitations to the Congress had been drawn up with much care to cover all the more important topics of discussion among anthropologists at the present moment, including matters of practical significance, such as the position of witchcraft in Africa under present administrative regulation. Attention will be confined here to a few of the questions discussed, without any implication as to their importance or interest in relation to others which must be passed over owing to limitations of space.

The opening remarks of the president of the Section of Anatomy, Sir Grafton Elliot Smith, when directing attention to the bearing of the study of race and culture on the claims now being put forward on behalf of the Aryans in the political life of Germany, and pointing out that the only contribution the Aryans could have made to the culture of early Mesopotamia was to borrow from it, struck a note which was characteristic throughout the proceedings of all the sections. This was the realisation that the study of man deals with a living subject of vital import to man. It was apparent not merely in questions of direct practical applications, such as the problems of dysharmonic cultural contact and administration in tropical and sub-tropical dependencies,. but also in other matters, such as descent and race, more often treated as though they were solely of scientific interest.

Two discussions in the Section of Anatomy were especially interesting in view of current controversy and discussion of method, one on "Man's Relation to the Primates", the other on the "Anthropological Aspect of Blood Grouping". The former was opened by Prof. W. E. Le Gros Clarke (Oxford), who argued that the human stem might already have become segregated at a much earlier stage in evolution than was generally supposed. It had been held that this took place in miocene times in a *Dryopithecus* group, which also provided the direct ancestors of the modern ape ; but recent discovery had established that the modern apes were fully differentiated by the beginning of the miocene. Prof. W. K. Gregory (New York) carried further his deductions from detailed comparison of the extremities of man and the apes, and Dr. L. S. B. Leakey (Cambridge) demonstrated the features, more particularly the characters of the teeth, upon which he had based his classification of *Homo kanamensis*, directly ancestral to modern man. The results of an examination of the palæontological evidence associated directly with early types of man with the view of determining the relative date of these types, by Mr. A. T. Hopwood (London), not only pointed to *Eoanthropus* as the earliest form, but also, in showing a closer affiliation of the human form with the western group of fossil anthropoids, lent support to the view that the place of origin of man might be expected to be nearer the west than the east. The president, in closing this session, said that the discussion, like others on this subject, had tended to consider man's place in time rather than his relation to the primates. While pointing to the high antiquity now attributed to modern man on the evidence of Dr. Leakey's discoveries in East Africa, as well as of the Lloyd's skull, he expressed some doubt as to the wisdom of basing a separate classification of *Homo kanamensis* on a pathological specimen.

In the discussion on blood-grouping, Prof. V. Suk (Brno) gave a comprehensive summary of work on this method of investigation of racial questions and more especially of recent developments. He stressed, though not unduly, the difficulty, as yet, of arriving at any clear-cut conclusion, and held that the new facts, in so far as they can be called fully established facts, cannot yet be completely correlated with other traits to represent a criterion in racial classification. Dr. H. J. T. Bylmer (Bloemendaal, Netherlands), on the other hand, in the light of his experience in the Dutch East Indies, endeavoured to find a resolution of such difficulties ; while Prof. Ruggles Gates (London) offered a genetical interpretation of the blood group with special reference to the problem of the American Indian. This pointed to isolated tribes from East Asiatic islands as the ancestors of the Amerindian post-glacial migrants. He referred also to the evidence from other peoples of peripheral distribution, and concluded that the blood-groups did

furnish important evidence of racial relationships, migrations and mixtures. They were also useful in confirming conclusions regarding crossing reached on the grounds of physiognomy. In Section *Ab* (Anthropometry) a great part of the time available was devoted to the discussion of the system of measurement in anthropometry and its technique. Important progress was made. Further attention will be given to this subject later.

In Section *B* (Psychology), a communication by Dr. C. S. Myers (London) was of special interest in its bearing on the current topic of mental characters and race. He pointed out that while primitive man of to-day, it had been found, was not radically different from his more advanced brother, most of such differences as were observed were material for the social psychologist, for they were mainly due to the social factors of environment and tradition; nevertheless, the possible inheritance of 'collective unconscious' factors could not be wholly ruled out.

In the same section, Prof. Arnold J. Toynbee (London), on "Psychological Problems which arise from the Contact of Cultures", said that the historians of the future would say that the great event of the twentieth century was the impact of Western civilisation upon all other living societies of the world of that day. The principle of national self-government had arisen in a West-European social environment, which was exceptional; but the Near Eastern peoples had been led by West-European d minance to 'scrap' their own institutions, and havoc had ensued.

In the final session of the Congress, a number of important resolutions were passed and research committees appointed. It was decided that the next meeting of the Congress should take place in 1938 in Copenhagen, the president to be Prof. T. Thomsen of Copenhagen.

Lightning and High-Voltage Power Transmission Lines

In a paper read to the South African Institute of Electrical Engineers in November last by E. F. Rendell and H. D. Gaff, an analysis is given of the faults due to lightning on the overhead lines connecting two stations—the Witbank and the Brakpan—belonging to the Victoria Falls and Transvaal Power Co. of South Africa. There are two parallel three-phase circuits connecting the two stations and the maximum load is 350 kilowatts. The voltage between phases is the same as that of the British Grid, namely, 132 kv. The three lines forming each set are of steel-cored aluminium and are in a vertical plane, the distance between the two planes being 23 feet. There is no transposition of the conductors (sometimes done to avoid interference with neighbouring telephones) and so they are parallel to one another. The distance between the top conductor of a set and the middle conductor is 12 ft., being the same as the distance between the middle and the lower conductor. An earthed guard wire was originally placed above the two sets at a distance of 18 ft. from the top wire of each set. The height of the lowest conductors from the earth averages 56 ft. The function of the guard wire is to 'protect' the circuits from lightning. There are 303 suspension towers for the circuits between the two stations.

Two cinematograph cameras were installed at Witbank, and one at Brakpan, three years ago. Any full voltage fault automatically starts the cameras recording. In this way, very complete film records have been obtained of the currents, voltages, etc., during every fault for the last three years. It is generally agreed that there are four possible ways in which a lightning fault may be caused on a power line. It may be due to the induced voltage in the conductors causing a rise of pressure which flashes over the string of insulators to the earth. Or it may be due to the lightning flash striking a suspension tower directly. It might strike a conductor directly. There is a possibility also that a streamer from a lightning flash to the earth might strike a conductor. The records provide some evidence that the first two causes are quite possible, but they only give negative results with regard to the last two.

It is well known that lightning faults are rarely evenly distributed along the length of a transmission line. In general, some sections of the line are immune from faults whilst in other sections, severe and continually recurring faults may be experienced. The reasons usually given are varying radioactivity on the geological strata causing more frequent flashes in certain locations. Variations in the electrical resistivity of the geological strata, which have the effect of altering the resistance to the earth of the various towers, may have an effect on the frequency of the occurrence of the faults. The records show that no faults occurred between towers 264–297, a distance of about six miles, and there were 65 between towers 120–164, a distance of roughly eight miles. Owing to faults recurring in a particular section, additional guard wires were erected over it. This, however, seems to have had the effect of increasing the number of faults.

The authors have found that there are appreciable differences in what happens when a fault on a single line occurs and when there is a simultaneous fault on two lines. The differences occurred so consistently that they indicate a fundamental difference in the active cause in the two cases. When a fault occurs on one of the circuits only, it is rare for more than one phase to be affected. With double-line faults, the majority occur on only one phase, but there are an appreciable number affecting two phases. Invariably the same phase or phases of both lines are affected. With single-line faults, the top conductor is the one most frequently affected; with double-line faults all phases are approximately equally affected. The equal distribution of faults between all phases in the case of double-line faults suggests that such a fault is due to a direct stroke on the tower causing an over-voltage, and consequently the highest conductors at the instant of the stroke are the ones affected.

The value of the resistance to earth of a tower seems to have little effect on the number of single-line faults that occur. With double-line faults, on the other hand, increasing the insulation diminishes their number without increasing the number of faults on neighbouring towers. The records show quite definitely that with single-line faults the conductor furthest removed from the earth is the one most frequently struck, whilst with double-line faults the conductors are all equally liable to be struck. They also show that with single-line faults additional

guard wires decrease the number of faults and protect the top conductor but apparently make the bottom conductor more liable to be struck. On the other hand, simultaneous double-line faults seem to occur more frequently when guard wires are used.

In spite of the severity of the storms that occur in the Rand, the operation of a single line of towers carrying two power lines has been successful. Since they started operation in April 1926 they have never been rendered unserviceable by a lightning fault. Most engineers would prefer to have two separate rows of towers several hundred metres apart each carrying three wires which form the edges of an equilateral prism. Some of the phenomena that would occur in this case would doubtless be similar to those observed by the authors.

Atmospheric Pollution

THERE is an impression that American cities are smoke free. This is only true to a limited extent, and in some respects Americans are very tolerant. The smoke of an American railway engine must be seen to be believed, and Dr. Meller's broadcast talk on December 28, 1933 ("The Smoke Abatement Outlook". By H. B. Meller. The Mellon Institute, Pittsburgh), tells a tale of the evil and damage done by smoke, which reads very familiar. He makes the point that following water, sanitation and food comes naturally the need to improve the quality of our air supply. "Remember," he says, "the demand we are now hearing for a new deal in air is coming from those who are living in houses of the type to which we long have been accustomed. How much stronger will be the cry for effective abatement of smoke when we begin to promote construction of the new style dwelling-house which science has developed. Samples of such houses were enthusiastically viewed for the first time by the masses at the Century of Progress Exposition. Small houses they are, with flat roof surfaces devoted to play spaces and sun parlours ; all of them equipped for air conditioning ; every one constructed so that each room can be flooded with sunlight. In short, dwellings designed to make much fuller use of free and inexhaustible health-giving natural resources—pure air and unfiltered sunlight. Smoke challenges the use and enjoyment of houses of the new type. Excessive air pollution largely defeats the purposes of a roof playground and sun parlor. The sooner we realise these facts, the quicker we will take steps to bring smoke under adequate control."

Dr. Meller goes on to plead for withdrawing exemption from smoke abatement ordinances from domestic fires and due attention to atmospheric pollution in schemes of rehousing. Both pleas are also relevant in Great Britain. The traditional pitched roof was inevitable so long as available weatherproof materials could only be got in small pieces, but quite unnecessary now that modern methods and materials of construction enable the flat roof to be easily made. Flat roofs would greatly increase the effective area of cities, as a glance at maps will show, and that without extending the boundaries. Moreover, this roof area, the most remote from traffic and noise, will be increasingly prized as smoke is diminished. The realisation of all this may be expected to increase the call for cleaner atmosphere by many who are now indifferent—householders, property owners and civic authorities. Unfortunately it is just here where individual action is so ineffective, and full benefit can only be realised by the construction of whole estates without smoky appliances. What an opportunity is presented by our new housing schemes if only it could be grasped !

The report of the investigation on air pollution described by the Department of Scientific and Industrial Research (H.M. Stationery Office. 5*s*. net) shows that systematic recording is increasing and that improvement of atmospheric conditions continues. Pollution by motor exhausts has been examined this year, but systematic recording is not deemed necessary. The deposit of tar, compared with the average of the previous five years, was lower by 14 per cent and of total solids by 11 per cent. Deposition of sulphates has also diminished. The highest figure was recorded at Ravenscourt Park, London, and the lowest at Templenewsam Park in East Leeds. Westminster is one of the worst spots in the country for smoke haze, from which again Coventry is practically free. Coventry is a model city in this respect, whereas London compares unfavourably with many industrial towns.

The limited measurements available indicate that the loss of sunlight due to air pollution averages 20 per cent over the year and more than this in winter. Last year the reasons for the fine records for Coventry were given as being partly geographical and partly the extensive use of smokeless methods in domestic and industrial practice. The lesson of these records cannot be too widely published at the present time. H. J. H.

University and Educational Intelligence

CAMBRIDGE.—The General Board has given notice that Dr. C. G. Lamb will resign the readership in electrical engineering on September 30, but it is not intended to recommend the continuation of the readership.

R. D. Davies, of Gonville and Caius College, has been appointed University demonstrator in engineering.

At King's College, A. M. Turing has been elected to a Harold Fry studentship, K. C. Dixon to an additional Harold Fry studentship and J. W. S. Pringle to a Martin Thackeray studentship.

At Trinity College, Dr. L. Borinski has been elected to a research studentship and W. E. Bennett and D. P. R. Petrie have been elected to Dominion and Colonial exhibitions in physics.

A CINEMA museum, wherein should be housed films of outstanding artistic and scientific merit, is advocated in an article by Elma Dangerfield in a recent issue of *Film Progress*. The project is linked with the scheme of the Shakespeare Film Society formed under the chairmanship of Sir Frank Benson. The same issue of *Film Progress* contains a very informative article by Charles Brawn, which relates how during the past five years he has evolved a successful technique of exhibition of films in schools, and formulates a number of definite conclusions arrived at by the school staff as a result of five years' experience. It seems clear that films are playing an increasingly important part in schools. A glance at a recent issue of a school magazine (*Stoic*, April) shows that the cinema figures prominently in seven separate reports of extra-curricular activities, including those of a natural science society, a natural history society, a film society and a motion picture

club, whilst a section headed "Entertainments" is wholly devoted to reviews of nine films. But, for examples of the most thoroughgoing exploitation of the cinema as an educational agency, one must turn to the schools of Japan. There, not only has every secondary school its motion picture study club, but also a constant flow of new pictures for use as an integral part of classroom work is supplied by the State. These serve both as aids to teaching geography, physics, chemistry, natural history and mathematics and for "fostering national morality through Japanese history. . . . This is the basis of our national education". The quotation is from a statement attributed to the Minister of Education in *School and Society* of March 3.

Science News a Century Ago

Darwin in the Andes

On August 14, 1834, Darwin set out on a riding excursion from Valparaiso. The first day brought him to the Hacienda of Quintero, which formerly belonged to Lord Cochrane. "My object in coming here," he said, "was to see the great beds of shells, which stand some yards above the level of the sea, and are burnt for lime. The proofs of the elevation of this whole line of coast are unequivocal: at the height of a few hundred feet old-looking shells are numerous, and I found some at 1,300 feet. These shells either lie loose on the surface, or are embedded in a reddish-black vegetable mould. I was much surprised to find under the microscope that this vegetable mould is really marine mud, full of minute particles of organic bodies". On the morning of August 16, he started the ascent of the Campana, or Bell Mountain, 6,400 ft. high, and the following day climbed to the top. "We spent the day on the summit," he wrote, "and I never enjoyed one more thoroughly. Chile, bounded by the Andes and the Pacific, was seen as in a map. . . . Who can avoid wondering at the force which has upheaved these mountains, and even more so at the countless ages which it must have required, to have broken through, removed, and levelled whole masses of them? It is well in this case, to call to mind the vast shingle and sedimentary beds of Patagonia, which if heaped on the Cordillera, would increase its height by so many thousand feet. When in that country, I wondered how any mountain-chain could have supplied such masses, and not have been utterly obliterated. We must not now reverse the wonder, and doubt whether all-powerful time can grind down mountains—even the gigantic Cordillera—into gravel and mud."

An Aerial Ship

On August 14, 1834, the *Morning Chronicle* gave a description of the great aerial ship which was then on exhibition on the premises of the Aeronautical Society, Paris, in the Champs Elysées. This novel conveyance consisted of a balloon 134 ft. long, 34 ft. high and about 25 ft. wide. It was in the form of the air-bladder of a fish, rather wide in the middle while the ends were in the form of pointed cones. It was described as capable of lifting 6,500 lb. The car, which was made of wicker-work, painted tricolour, was 66 ft. long and very narrow, with seats across it at regular intervals. It was fixed immediately under the balloon and it could accommodate thirty persons. The material of which the balloon was made was prepared in such a way as to preserve the gas for fifteen days. There were rudders at each end of the car and paddle wheels of canvas stretched over light iron frames on either side. The principal projector of this gigantic undertaking was M. Lennox, formerly a superior officer in the French Army. A trial was to have been made on August 15, but it was postponed until August 17. On that day, great crowds assembled to see the gigantic balloon ascend, but at 12.30 p.m., just when the fully-inflated balloon was being drawn down for the aeronauts to embark, it turned upside down and burst with a loud explosion.

The Worcestershire Natural History Society

Referring to the publication of the "Illustrations of the Natural History of Worcester" by C. Hastings, M.D., the *Athenæum* of August 16, 1834, said: "We notice with sincere pleasure this first fruit of the Worcester Natural History Society being the substance of an introductory lecture delivered to them by Dr. Hastings, and including general views, comprehensive and interesting, of the Statistics, Geology, Botany, Zoology and Meteorology of that country. Gladly would we hail the establishment of such a Society in every county in England, as nothing, we conceive, would so decidedly tend to the collection, as well as diffusion of useful knowledge, to binding together all ranks in the pursuit of science, to promoting universal harmony and good will, and to ameliorating the conditions, both of the upper and labouring classes, by making them better acquainted with the necessities, the interests and the feelings of one another."

The Göttingen Magnetic Observatory

The study of terrestrial magnetism in the earlier part of the nineteenth century led to the formation in 1834 of the German Magnetic Union and the erection by Gauss of the Magnetic Observatory at Göttingen. This Observatory and its equipment were described in the number of the *Göttingische gelehrte Anziegen* of August 1834, a translation of the article being afterwards published in the *Philosophical Magazine*. The observatory was about 100 yards from the Astronomical Observatory, and formed an oblong about 32 ft. by 15 ft. Everything in the building usually made of iron, such as locks, hinges, etc., was of copper, and draughts were prevented as much as possible. The principal instrument was the "magnetic bar made of Uslar cast steel which is particularly fit for magnetical observations". It was 610 mm. in length and weighed about 4 lb. It was suspended from the ceiling by a 200-fold untwisted silk thread, and the inconvenience caused by the stretching of the threads was overcome by an ingenious device due to W. E. Weber, the colleague of Gauss. Besides Gauss and Weber, Ulrich, Goldschmidt, Listing, Sartorius, Deahna and W. Gauss had made observations, while Sartorius had made observations at a country house in Bavaria. The concluding paragraphs of the article refer to the "double line of wires from the cabinet of natural philosophy over the houses of the town to the astronomical observatory", which had been continued to the magnetical observatory, thus forming a chain by which the galvanic current, including the multipliers attached to each end of the chain, has to run through a length of wire nearly 9,000 feet. "This arrangement," it was said, "is likely to produce the most interesting results."

Societies and Academies

Dublin

Royal Irish Academy, June 11. A. E. Muskett, H. Cairns and E. M. Carrothers: Further contributions to the fungus flora of Ulster. This paper represents a further contribution to the known fungus flora of Ulster, the first contribution being made in 1931 (*Proc. Roy. Irish Acad.*, **49**, Sect. B, No. 2; 1931). It adds 284 species and varieties to the previous records, the total number recorded up to the date of writing being 1,199. A large number of these additions were made during the visit of the British Mycological Society in 1931 when forays were made to some of the better known woodlands. 141 of the species and varieties listed are noted as being new Irish records. Two of the species and one variety constitute new British records. These are *Hygrophorus agathosmus*, Fr. var. *aureofoccosus*, Bres., and *Tulasnella anceps*, Bres. and Syd. Both were recorded during the visit of the Society, the latter being parasitic on *Pteris aquilina*. The other new British record, *Phytophthora Megasperma*, Drechsler, was isolated by one of the writers from a potato tuber affected with pink rot.

Edinburgh

Royal Society, July 2. W. J. Hamilton: The early stages in the development of the ferret. (1) Fertilisation to the development of the prochordal plate (studied in living and sectioned material). The living unsegmented and segmented eggs of ferret show a perivitelline space in which vitellus and polar bodies move independently. At fertilisation, the entire sperm enters the ovum. The cells arising from the first division are similar in appearance, but differ in size; statistically this difference is not significant. The cells do not divide synchronously. At the four-cell stage there is a small cell. The blastocyst cavity is intercellular; the central cell mass is composed of a few cells covered with trophoblast and later forms a flattened disc. The endoderm arises by delamination, the cells are at first flattened. A. E. Cameron: The life-history and structure of *Hœmtopota pluvialis*, L. (Tabanidæ). Commencing with females captured in the field and induced to oviposit in the laboratory, the metamorphosis of *H. pluvialis* is described. It is the first European species of tabanid the life-history of which has been traced and the number of larval instars determined. They were found to vary from seven to nine. The species is uni- or demi-voltine. From the same batch of eggs, individuals were reared that took, some one year, others two years to complete their life-histories, although the conditions of rearing were alike for all. It is suggested that *H. pluvialis* is heterozygous for univoltine or demivoltine characters. The lava and pupa occur in moist soil. The anatomy of the larva is discussed, including the unique head capsule, the alimentary, tracheal and nervous systems. The peculiar organ of Graber is described in detail, a comparison drawn with that of other tabanid species, and its probable function discussed. The larva and pupa of *H. pluvialis* and *H. americana* are compared. H. H. Brown: Study of a tectibranch gasteropod mollusc, *Philine aperta*, L. This tectibranch lives in the soft mud of British estuaries, in which it ploughs its way by means of the cephalic disc. This organ is shown, on both comparative anatomical and developmental grounds, to be formed by the fusion of the two cephalic tentacles. The radula is modified so that it works in the manner of a mechanical grab; the apparatus is protruded from the mouth, and by a sweeping movement of opposing sets of long radular teeth, food is picked up and drawn into the mouth. The animal relies in searching for food upon the rhinophores, and also upon a pair each of cephalic and pedal pit sense organs near the mouth, here described for the first time. The development is traced from the veliger newly liberated from the spawn mass, to a stage which has lost the velum, and has assumed several adult characters, including the cephalic disc and the gizzard. A. Graham: The structure and relationships of lamellibranchs possessing a cruciform muscle. Lamellibranch molluscs which possess a cruciform muscle have hitherto been classified partly as Tellinacea and partly as Solenacea, in which also occur the razor shellfish, which have no cruciform muscle. An investigation of the anatomy of these animals shows that in many points the members of the Solenacea which possess a cruciform muscle, the Solecurtidæ, resemble the Tellinacea and differ from the Solenidæ. The differences justify the union of all lamellibranchs with a cruciform muscle in the Tellinacea, leaving the Solenacea including only animals without one. Ralph Dennell: The feeding mechanism of the cumacean crustacean, *Diastylis bradyi*. The feeding mechanism of *Diastylis* is probably derivable from the primitive mysid arrangement. The powerful respiratory current enters the large carapace antero-ventrally, and flows out through the rostral siphon, the rostral valve opening by water pressure behind it. Movements of the maxillæ and maxillipeds with regard to a peculiar median process produce a filter current, which is aided by the respiratory current. After an examination of *Apseudes* it is hoped to describe the probable evolution of feeding mechanisms along the line leading from some primitive mysid and culminating in the Isopoda. T. M. MacRobert: Some integrals, with respect to their degrees, of associated Legendre functions. A number of integrals of this type are evaluated by different methods, including contour integration, Fourier's integral theorem and expansions in series.

Paris

Academy of Sciences, June 18 (*C.R.*, **198**, 2129–2216). The president announced the death of Henri Lecomte, member of the Section of Botany. J. Cabannes: The radiations of the night sky in the spectral interval 5000–8000 A. The results generally confirm those of Sommer. G. Mihoc: Discontinuous multiple chains. Jacques Valensi: Trajectories and instantaneous velocities in the field of an aerial screw D. Barbier, D. Chalonge and E. Vassy: The comparison of the continuous spectra of some stars of the *A* and *B* types. Nocturnal determinations of ozone. A. Fortier: The measurement of pressures by the photographic determination of the levels reached by liquids in tubes. J. Bernamont: The experimental study of the fluctuations of resistance in a metallic conductor of small volume. Details of experiments with a platinum wire of 1 micron diameter. J. J. Trillat and H. Motz: The diffraction of electrons by india-rubber. The results obtained by electron diffraction confirm the view, already proved with the X-rays, that stretched india-rubber shows a phenomenon of pseudo-crystallisation.

This effect is unstable and disappears in about 24 hours. It is concluded that the isoprene chains are arranged in the plane of the surface of the film. N. THON: Electrode capacity in the presence of foreign ions and the electrocapillary capacity of mercury. A. ROUSSET: The diffusion of light by binary mixtures in the neighbourhood of the critical point of complete miscibility: measurements of the depolarisation factor. L. HERMAN: The (light) absorption of oxygen between 7000 and 3000 A. Study of the absorption spectrum of oxygen, in a tube 100 metres long and under a pressure of 10 kgm./cm.^{2}. NY TSI-ZÉ and CHOONG SHIN-PIAW: The influence of the electric field on the absorption spectrum of rubidium. HENRYK NIEWODNICZANSKI: An experimental demonstration of the existence of dipolar magnetic radiation. ANDRÉ CHARRIOU and MLLE. S. VALETTE: Linear deformations of nitrocellulose films as a function of the atmospheric humidity. In photography from the air, the variations in the linear dimensions of the films interfere with high precision work. The effect of the hygrometric condition of the air on the film has been studied. When the humidity increases 1 per cent the linear dimensions of the films increase 0·01 per cent. H. HULUBEI: Methods of focalisation in the analysis of crystalline powders and in the spectrography of the X- and γ-radiations. W. SWIETOSLAWSKI and B. KARPINSKI: The displacement of the azeotropic point of the ternary azeotrope (benzene, ethyl alcohol, water) as a function of the pressure. O. BINDER: The action of aqueous solutions of copper sulphate on cupric oxide. The basic copper sulphate, $4CuO, SO_3, 4H_2O$, has the same physical properties (X-ray diffraction spectrum, magnetic susceptibility) whether prepared with blue copper hydroxide or black copper oxide. A. TRAVERS and YU KWONG CHU: The hydration of phosphoric anhydride. The addition of water to phosphoric anhydride, taking every possible precaution to avoid local heating, always gives a mixture of two varieties of metaphosphoric acid, one not coagulating albumen and giving pyrophosphoric acid on hydration, the other more polymerised form, coagulating albumen and hydrating directly to orthophosphoric acid. MLLE. AMAGAT: Contribution to the study of the α-di- or trisubstituted amides. M. TIFFENEAU and MLLE. I. NEUBERG: The action of phenylmagnesium bromide on lævorotatory dibenzoylglyceric aldehyde. The formation of lævorotatory α-dibenzoylphenylglycerol. MLLE. M. DARMON: Study of the hydration of two phenylglycides: 3-phenyl-2,3-epoxy-2-propanol and 1-phenyl-2,3-epoxy-1-propanol. The formation in each case of the two α and β phenylglycerols. R. LESPIEAU and RENÉ LOMBARD: The preparation of enynols and the passage from these to the dienols. RINGEISSEN: The mobility of the halogen in the α-halogen-β-naphthols. L. PALFRAY and M. ROTBART: Some monoalkoxy ethers of glycol, with high molecular weight. E. BERGER: The aqueous mortars obtained with organic binders. ALBERT F. DE LAPPARENT: The fold of Salernes (Var), its foundation and its connexions with the Lorgues folds. ANTONIN LANQUINE: The structures of the Provençal chains in the south of the Basse-Alps. D. SCHNEEGANS: Preliminary palæontological study of the fossils collected by R. Lambert between Agadez and Zinder (Niger). MLLE. F. FLOUS: The notion of phyllorhize in the cork oak. R. J. GAUTHERET: Culture of the cambial tissue. BROULAND: The existence of trachids in the flower of some species of the family of the Ranunculaceæ. MLLE. L. MEYER: The variation of the apparent rH of the soil during the growth of plants. LUCIEN BERLAND: The study with an aeroplane of the aerial entomological fauna. M. and MME. A. CHAUCHARD: The measurement of the cortical excitability by the percutaneous method after craniectomy and cicatrisation. P. E. THOMAS and P. DE GRAEVE: Dextrorotatory allantoin, its presence in animals. A. CHEVALLIER, MLLE. Y. CHORON and J. GUILLOT: A substance A′, intermediate between vitamin A and β-ionone. E. BRÉDO: The microbial and cytolytic origin of turbidities of hygienic drinks. ANDRÉ BOIVIN and MME. LYDIA MESROBEANU: The chemical properties of a toxic and immunising substance isolated from the B. Aertrycke bacillus.

GENEVA

Society of Physics and Natural History, March 15. W. H. SCHOPFER: An attempt at generalising the action of the growth factor in the Mucorineæ. The accelerating action of extracts of wheat germ and of yeast extracts is seen in all the Phycomyces observed. It is much weaker in other species of Mucorineæ. The vitamin action shows itself equally on the plant development. W. H. SCHOPFER: (1) The action of crystallised vitamins B_1 and B_2 on a micro-organism. The crystallised vitamins, Windaus (B_1) and Kuhn (B_2) act in an intense manner on the development of Phycomyces. In the proportion of 0·05γ per c.c. of the culture medium, the effect is still felt. (2) The existence in the pollinia of orchids of a growth factor for micro-organisms. The aqueous extract of the pollinia contains a thermostable substance accelerating the development of Phycomyces. P. ROSSIER: (1) Comparison of two criteria of spectral classification of stars. Going up in the series of star spectra, the importance of the ultra-violet diminishes and the width of the K line increases. Even in the spectral class $F0$ of the Henry Draper catalogue their application gives concordant results. Working on a sufficient number of spectra, measurements of the width of lines or of the length of various parts of the spectrograms give the spectral class. (2) The central wave-length in astronomical spectrography. The author thus names the wave-length which, taken as origin in a stellar spectrogram, makes homogeneous the linear relation which exists between the extremities of the spectrogram. Although differing from the effective wave-length, its behaviour is analogous with that of this quantity. G. GUTZEIT and R. WEIBEL: The use of the antipyrine-iodide reagent in analysis with the spot test. This reagent can be utilised in qualitative spot test analyses on condition that the arsenic ion is oxidised and that the oxidising effect of the ions at the maximum is avoided by a preliminary treatment of the solution with formol. The antimonous ion can be detected in the presence of other ions of the same sub-group by working according to the author's directions. D. ZIMMET and E. FROMMEL: The action of muscle extract (lacarnol) and of pancreatic extract deprived of insulin (padutine) on the nervous system of the frog. These two products injected into the frog produce irregular movements resembling chorea. Hence it would appear that in addition to their vasomotive action, they have an effect on the central nervous system. G. TIERCY: The equation of condition for the extremes of ionisation in the peripheral layer of a variable star. The author gives the equation which

must be satisfied before dealing with the phase of maximum ionisation: he expresses the terms as a function of the variation of temperature and of the variation of magnitude.

ROME

Royal National Academy of the Lincei, Feb. 18. F. ENRIQUES: Elliptical surfaces of zero genus. P. BURGATTI: Displacement of the perihelion in the theory of relativity. G. BRUNI and G. NATTA: Structure of guttapercha, studied by electron rays. By the action of electron rays, crystalline or α-gutta-percha is rapidly transformed into the amorphous β-form. The α-variety has rhombic or pseudorhombic structure, with the axial ratios 1 : 1·176 : 1·47. On the assumption that unit cell contains four isoprene groups, the calculated density is 0·94, which agrees well with the most recent experimental data. A. ROSENBLATT: Non-linear m-harmonic equations with two independent variables. (1) Green's m-harmonic function in the case of the circle. M. GHERMANESCO: Trigonometric sums of Alaci. R. EINAUDI: Propagation of superficial elastic waves. D. GRAFFI: The eccentricity of the orbit in the problem of two bodies of variable mass. D. C. LEWIS, JR.: Periodic oscillations of a dynamic system. L. SONA: Translo-circulatory current investing a bilateral lamina. L. SOLAINI: A particular case of the problem of the vertex of a pyramid. A. MISSIROLI and A. CORRADETTI: The possibility of the phenomena of hybridism in malarigenic parasites. G. CIACCIO: Regeneration of the crystalline in examples of various ages of *Salamandra maculosa* and regeneration of the crystalline in transplanted eyes of *Triton cristatus*. G. BRUNELLI and G. BINI: The emigration of a species of *Teuthis* from the Red Sea to the Ægean Sea.

Official Publications Received

GREAT BRITAIN AND IRELAND

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd., Turner's Hill, Cheshunt, Herts. Nineteenth Annual Report, 1933. Pp. 115. (Cheshunt.)

Education (Scotland). Report for the Year 1933 by the Director on the Royal Scottish Museum, Edinburgh. Pp. 13. (Edinburgh.)

British Empire Cancer Campaign. Eleventh Annual Report of the Grand Council presented at the Meeting held at the House of Lords, 9-7-34. Pp. xxiii+220. (London: British Empire Cancer Campaign.)

Imperial Agricultural Bureaux. Fourth Annual Report of the Executive Council, 1932-1933. Pp. 23. (London: H.M. Stationery Office.) 1*s*. net.

Transactions of the Institution of Chemical Engineers. Vol. 11, 1933. Pp. 227. (London: Institution of Chemical Engineers.)

Ministry of Agriculture and Fisheries. The Agricultural Output of England and Wales, 1930–1931: Report on certain Statistical Enquiries relating to the Output of Agricultural Produce and to the Agricultural Industry in general, together with Results of Earlier Enquiries of a similar Nature. (Cmd. 4605.) Pp. 67. (London: H.M. Stationery Office.) 1*s*. net.

Falmouth Observatory. Report of the Joint Observatory Committee to the Royal Cornwall Polytechnic Society and to the Falmouth Town Council for the Year 1933. Pp. 3. Meteorological Notes and Tables for the Year 1933, also Additional Meteorological Tables of Temperature, Rainfall and of Sunshine, 1880–1933, and Miscellaneous Phenomena during 1933. Pp. 11. (Falmouth.)

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1933. Pp. 214+7 plates. (Bristol.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 7: Report of the Irish Radium Committee for the Year 1933; including Reports by Oliver Chance, Dr. W. G. Harvey, W. J. MacHugh and Oswald J. Murphy. Pp. 59–66. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1576 (Spin. 107, 138): Spinning of Pterodactyl Mark IV. Part 1, by A. V. Stephens and J. Cohen; Part 2, by A. V. Stephens. Pp. 10+2 plates. (London: H.M. Stationery Office.) 9*d*. net.

Amgueddfa Genedlæthol Cymru: National Museum of Wales. Welsh Flowering Plants: a Handbook to the Collection in the Welsh National Herbarium. By H. A. Hyde and A. E. Wade. Pp. vii+179+2 plates. (Cardiff: National Museum of Wales; Press Board of the University of Wales.) 5*s*.

OTHER COUNTRIES

Bernice B. Bishop Museum. Bulletin 115: Archæology of Kahoolawe. By J. Gilbert McAllister. Pp. 61+5 plates. Bulletin 116: Stone Remains in the Society Islands. By Kenneth P. Emory. Pp. 182+20 plates. Bulletin 117: Astelia and Pipturus of Hawaii. By Carl Skottsberg. Pp. 77+38 plates. Bulletin 118: Tuamotuan Stone Structures. By Kenneth P. Emory. Pp. 78+10 plates. Bulletin 119: Geology of Vitilevu, Fiji. By Harry S. Ladd. Includes Petrography, by Arthur A. Pegau; Smaller Foraminifera, by Joseph A. Cushman; Larger Foraminifera, by G. Leslie Whipple; Corals, by J. Edward Hoffmeister; Smaller Echinoids, by H. L. Hawkins; Decapod Crustaceans, by Mary J. Rathbun. Pp. 263+44 plates. Bulletin 120: The Flora of Makatea. By Gerrit Parmile Wilder. Pp. 49+5 plates. Bulletin 121: Some Hawaiian Oribatoidea (Acarina). By Arthur Paul Jacot. Pp. 99+16 plates. Bulletin 122: Mangaian Society. By Te Rangi Hiroa (P. H. Buck). Pp. 207. Bulletin 124: Report of the Director for 1933. By Herbert E. Gregory. Pp. 44. (Honolulu.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 106: On the Uplift acting upon a Heated Fibre vertically suspended in Gas. By Yositada Takenouti. Pp. 337–384. (Tôkyô: Koseikai Publishing House.) 40 sen.

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 26, Part 4: Flora of Hokkaido and Saghalien: 4: Dicotyledoneæ, Archichlamydeæ, Saururaceæ—Polygonaceæ. By Kingo Miyabe and Yushun Kudo. Pp. 389–528. (Tokyo: Maruzen Co., Ltd.)

A Field Study of the Behavior and Social Relations of Howling Monkeys. By C. R. Carpenter. (Comparative Psychology Monographs, Vol. 10, No. 2.) Pp. 168 (16 plates). (Baltimore, Md.: Johns Hopkins Press.) 2.25 dollars.

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NATURE

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CONTENTS

The Aryan Doctrine

HOWEVER much we may feel assured that ultimately truth will prevail, in the practical affairs of life it often befalls that we must watch the dry light of reason pale and flicker in the hot breath of a theory which, illogical and perversive of fact though it may be, appeals to the emotions, the passions and the interests, of the uninstructed, but socially and politically powerful, elements among mankind. The dogma of the Aryan race, which recently has burst like a shell over an astonished world, though formulated on a view of racial affinities fundamentally obsolete and a biased interpretation of archæological fact, with the aid of the mystic symbols of the swastika, the arm raised in salute and a Messianic leader, has swept Germany off her feet by setting up an ideal, which recalls the ancient glories of the Germanic peoples in a period of political and economic depression, and holds out a promise of their revival through a racial regeneration.

It is unfortunate, but true, that an ideal theory which can mould facts to its purpose holds the superior strategic position. The populace is ever impatient of the impartial attitude of a scientific investigation of fact, which must often, by the qualification and limitation of its conclusions owing to imperfect knowledge, provide a check rather than a spur to immediate action. In the discussion of the population problems of the United States, it is the voice of the facile theorist which has been heard, while the scientific investigator of race, who refrains from dogmatism pending fuller inquiry, is still crying in the wilderness. In Germany, any who in their teaching might have been able to criticise the officially accepted view of the racial origins and character of the German people, have been forbidden to lecture on race on the ground that they are unfitted to meddle in an affair of so great practical moment.

Happily such restrictions do not run outside Germany, and although the anthropologist is not concerned with political propaganda as such, when racial theory is invoked in support of social and political action, the basis of argument must be such as will stand the test of scientific examination. The Aryan race doctrine as now held in Germany rests upon concepts, assumptions and theories hitherto generally regarded as untenable or discredited, and until recently accepted only by a few. Mainly they were familiar as the stock-in-trade of popular writers and semi-journalistic publicists

during and after the War. Notwithstanding their popular vogue and certain repercussions in the political world, scientific opinion had not been disposed to regard these concepts with any great degree of concern until their adoption as one of the main driving forces in the Nazi movement attracted a more widely diffused attention.

But contagion spreads; and when a British Cabinet Minister thinks it desirable to affirm his Aryan extraction, then the doyen of anthropologists, the president of the Royal Society, and a leading exponent of the biological study of race, may well combine to protest against the revival of a scientific heresy. The letter from Dr. A. C. Haddon, Sir F. Gowland Hopkins and Prof. J. B. S. Haldane, which appeared in the *Times* of August 7, is an opportune admonition to others, beside Sir John Simon, that men of science outside Germany cannot accept a political faith in the guise of scientific theory without reference to its relation to scientifically assured fact.

It was disastrous for Germany that the first step she elected to take in national regeneration through racial integration should have assumed a form which alienated liberal opinion throughout the whole world, at a time when the racial theory upon which it was based was neither well nor widely known. The crude statement of Nazi argument for discrimination against the Jews on the ground of racial inferiority appeared absurd and almost carried its refutation with it. Apart from the impossibility of analysing the culture of modern Germany in terms of the racial elements of her population—a task from which even the most rash of racial psychologists might well shrink—it was shown time and again that the unquestioned eminence of Germany in the arts and sciences was due in no inconsiderable measure to her nationals of Jewish extraction and descent. It is difficult for an onlooker to appreciate the attitude of mind which can so far run counter to the logic of facts as to impute racial inferiority to the Jew. It has all the appearance of the crudest race prejudice. Germany, however, with a thoroughness that is characteristic, especially in its lack of humour, justifies her action with an appeal to first principles. The Jewish type and Jewish mentality, with its proclivity to socialism and internationalism, it is argued, is incompatible with the German type. But this German type is an ideal type, evolved, like the camel in Heine's story, from the Teutonic inner consciousness and projected into the past, as so often happens with an ideal. It is, in fact, the familiar illusion of the Golden Age; and race prejudice has been transformed into an inevitable measure of purification in the endeavour to recreate a hypothetical ancient German character and culture.

Needless to say, this is not the German view; and confirmation of the conception of a Germanic type, embodying all the virtues of a superman, is found in the evidence of archæology and racial history. Herr Hitler himself affirms in "Mein Kampf" that the Aryans alone among the peoples of the world have been 'founders of culture', and another prominent official of the Reich, Dr. Frank, is reported to have declared that from the substance of the Germanic race have issued the highest achievements of man, so that it might be considered the duty of the entire human race to safeguard this basic element. This may come as a surprise to those who are not familiar with certain lines of argument in the racial question. It is a view which derives from the middle of the last century and the theories of the Comte de Gobineau, in which the Aryans, the white races *par excellence*, were regarded in their mission to mankind at large as only a little lower than the angels.

An official but popularised version of the basis of present-day German political theory will be found in the translation of the circular issued by Dr. Frick, the Minister of the Interior, which appeared in Nature of February 24, 1934, p. 298. The attention attracted by the misuse of the linguistic term 'Aryan', as significant of race, and the adoption of the swastika as the Aryan symbol, have tended to an unfortunate concentration of criticism on an obvious appeal to sentiment. Notwithstanding the views which have been expressed by Sir Arthur Keith, there seems no good reason to condone the resuscitation of the 'Aryan race' abandoned by Max Müller under criticism. It is, however, in the exclusiveness of its use as the equivalent of 'Nordic' that lurks the sin against the scientific spirit, for with it comes a whole train of assumptions and interpretations which at times fail to pass the bounds of purely imaginative speculation.

Briefly, the German doctrine of the Aryan race is that the tall, long-headed, fair-complexioned Nordic peoples of northern Europe are the modern representatives of the original Aryans. To this race is due the high standard of culture found throughout the civilised world. Not only is this true in antiquity, in the civilisations of Mesopotamia, Egypt, the Mediterranean and so forth, but

even the contribution to culture of Romance countries in modern times is to be attributed to descendants of the Nordic race. They were endowed with certain bodily characters, which represent the highest evolution of the human form; and in addition they possessed, as a racial inheritance, certain outstanding mental qualities. It was in virtue of these physical and mental characters that they became the ruling classes in most ancient and modern societies. Wherever the Nordic strain is mixed with other breeds, it is said, it deteriorates. The aim of the State, therefore, must be to preserve the purity, integrity and dominance of the Aryan race, biologically, socially and politically.

It would be beyond the present purpose to enter into a detailed examination of these interpretations of ethnological, archæological and historical fact, or to weigh the probabilities that the earliest Aryan-speaking peoples were Proto-Nordics, who carried their tongue to the other races of Europe. That the Nordics were a far wandering people who irrupted into many lands is unquestioned; but as nomads their early culture was crude, and the people they conquered must almost invariably have been of a higher culture than themselves. But whatever their cultural status, a strict anthropometric measure applied to the modern population of Germany would find true Nordics in all their racial purity in an embarrassingly small minority.

That Germany has adopted a highly coloured interpretation of history, which in the greater part of its detail would not stand the test of a moment's impartial examination, is a matter of lesser import beside the fact that, by the forcible imposition of certain views on race and racial history, assumption has been taken as proof; and research and its results, unless 'orthodox', have been banned on a number of questions such as racial heredity, racial admixture, the relation of race, mentality and culture, and the like, upon which science would hesitate to pronounce finally in the light of the evidence available. Such dogmatic assumptions, unfortunately, have their attraction for the political doctrinaire and the agitator; and it is perhaps to be regretted, therefore, that the International Congress of Anthropological and Ethnological Sciences did not see its way to promote investigation into such racial problems on broad lines. The machinery may seem overweighty; but at least the truth would have been made available in authoritative form to all.

Finite Differences

The Calculus of Finite Differences. By Prof. L. M. Milne-Thomson. Pp. xxiii+558. (London: Macmillan and Co., Ltd., 1933.) 30*s*. net.

THE last edition of Boole's "Finite Differences" appeared in 1880, and was in fact a reprint of the edition of 1872. The interval of sixty years has seen in the elementary field Sheppard's introduction of central differences, Thiele's strange invention of reciprocal differences, Everett's discovery of the interpolation formula that bears his name, and the recent development of methods of numerical interpolation which dispense with formulæ altogether; Poincaré's attention to the asymptotic behaviour of solutions suggested new and tractable problems regarding insoluble equations; as a branch of analysis the calculus of finite differences has been revolutionised by Nörlund in the course of the last twelve years; Birkhoff, to add one name which is absent from the book under review, has handled the system of linear difference equations by matrix methods which would have won Boole's heart. The publication of an English treatise on finite differences is therefore something of an event to the student of mathematics in Great Britain.

Not that Prof. Milne-Thomson is everywhere on ground that English authors have left untouched since the days of Boole. He follows precedent in dealing in his early chapters not only with the formal algebra of the elementary operators but also with its application to the problems of numerical interpolation, differentiation and integration. These problems come within the domain which Whittaker happily names the calculus of observation, and the only part of Prof. Milne-Thomson's discussion of them which is not in essence familiar is a clear account of the iterative processes of interpolation that have been devised during the last three or four years; these processes could certainly not be ignored in a treatise on numerical analysis, but since their whole point is that what is required in computation is a process and that the existence of a corresponding general formula is irrelevant, it must be admitted that with their development the problem of interpolation extends beyond the bounds of the calculus of finite differences; that Prof. Milne-Thomson should have felt that an account of interpolation which omitted them would be misleading is all the more significant.

Analytically, the calculus of finite differences

must depend ultimately on a complete understanding of the relation that subsists between two functions $u(x)$, $\varphi(x)$, when $\Delta u = \varphi$. If u is given, φ is determinate, but the converse is not true: for a given φ, two solutions in u may differ by an arbitrary function of unit period. It follows that a solution may have specified values at any finite number of points within a unit range, and cannot be rendered determinate by the assignment of any finite assortment of values; this cannot, however, imply that a solution, if it is to be analytic, may have arbitrary values throughout any interval, since a function u specified throughout an interval would be determinate in virtue of being analytic, independently of the postulated relation to the given function φ. The problem of defining a suitable standard solution with which other solutions are to be compared is thus seen to be by no means simple; Ramanujan's note-books contain some characteristic suggestions, and the problem was at length solved by Nörlund in a paper which appeared in *Acta Mathematica* as recently as 1923. It may be mentioned that Nörlund's definition, when $\varphi(x)$ is $1/x$, leads to the logarithmic derivative of the gamma function; at last the gamma function, too often introduced by "Consider the infinite product . . .", is seen to be inevitable.

The study of difference equations or recurrence relations, like that of differential equations, began long ago with the search for soluble examples. But when this chapter came to an end through exhaustion of material, and the interest in differential equations turned on the existence and nature of solutions, the corresponding line of advance for difference equations was not open. Under Weierstrass's influence, the power series was regarded as in some sense the only genuine expression of an analytic function, and the investigation of the character of the solution of a given equation could mean nothing but the study of the solution by means of power series. Since the substitution of a power series for the dependent variable in even the simplest type of difference equation obviously leads nowhere, progress seemed to depend on comparison with equations of which solutions happened to be known: there was no second chapter, but only a continuation of the chapter which ought to have been closed. But, as has long been known, the formal solution of simple types of difference equation is possible in series not of powers but of factorials or inverse factorials. With the recognition in the theory of numbers of what we may call the right of Dirichlet series to independent existence was bound to come a change in the outlook on difference equations; accepting the appropriate series as the fundamental form of expression of the functions of which he is in want, the mathematician inquires directly into the analytical nature of functions expressible in this way. If it cannot be said that Nörlund was the first to adopt the new point of view, the deliberate investigation and the systematic exposition are both his.

It will now be clear that to say that the second half of Prof. Milne-Thomson's book is to a great extent a reproduction of Nörlund's work is no disparagement; on the contrary, a good treatment of the calculus of finite differences at the present moment can be nothing else. The polyglot mathematician will rely on Nörlund's own memoirs and treatises; to the monoglot who cannot or will not study a subject until it is presented to him in English, Prof. Milne-Thomson has done a real service. He writes clearly, and if the invariable use of the subjective after 'if' be a matter of principle with a writer, he must not be blamed for the practice, even if the habit be one by which some readers are irritated.

There are, of course, serious omissions from this treatise, but the book is so large that one must not say what might have been added without suggesting how room might have been found. Prof. Milne-Thomson is not prolix, and condensation of the present material would not have been satisfactory. Perhaps the pity is that he did not break with precedent and separate the two components of the book into independent volumes; the first seven chapters are complete as a textbook on interpolation, and an additional hundred pages would have made all the difference to the range of the analysis.

A grave flaw in the book is the haphazard nature of the references. To reproduce the bibliography which occupies 68 pages at the end of Nörlund's "Differenzenrechnung" would have been absurd. That the only hint of the existence of Nörlund's book is a casual "See also *Differenzenrechnung*, ch. iii" following the one reference to his *Acta* memoir of 1923 is to go to the other extreme. It is not that Prof. Milne-Thomson is grudging in his acknowledgements. But it is impossible to learn from him which are the substantial contributions to the calculus. The index gives an impression which is wholly misleading, for the names to which the largest numbers of entries are attached are the author's own (18),

Nörlund (16), Whittaker and Watson (11), and Knopp (9); the last two sets are concerned with theorems on analysis or on series, not with work on finite differences, and the first set is swollen by eight references to numerical tables from which extracts are made for purposes of illustration.

Prof. Milne-Thomson suggests two additions to the notation of the calculus. He would have a special symbol for operational equivalence, and when he wishes to represent Σ as an inverse operator, he replaces Σ by P^{-1}. Whether it is necessary, in mature work, to distinguish between different uses of the sign of equality, is doubtful; that the author himself does not succeed in maintaining the distinction he proposes is significant, and on any interpretation chains (pp. 33, 125) in which the same expression is equated on one hand by the usual symbol and on the other hand by the operational symbol are palpably absurd. With regard to P, we are not told, either here or in the paper in which the symbol was introduced, how P is different from Δ. E. H. N.

Science and Values

Science and the Spirit of Man: a New Ordering of Experience. By Julius W. Friend and James Feibleman. Pp. 336. (London: George Allen and Unwin, Ltd., 1933.) 12*s.* 6*d.* net.

IT would seem that the number of stately rebukes of scientific arrogance, insufficiency, muddle-headedness and general aridity is increasing, so that the scientific worker must soon perforce clothe himself in sackcloth and ashes and do penance at the new shrines of a fickle public. It is true that in the present work the authors launch their attack less against science itself than at the weird metaphysical speculations with which so much of scientific (?) literature is now encumbered; but in the absence of louder, clearer and oft-repeated disclaimers, science itself must bear some of the responsibility for the darkening clouds of doubt and disaffection with which its domain is now threatened from many quarters.

This work, like many others, is mainly concerned with values many of which are supposed to be belittled or ignored in what is called the modern scientific cosmology. The world has hitherto followed the scientific worker faithfully, if perhaps a little blindly, in demanding "hard, stubborn facts"; though, strangely enough, it has been content to accept only those which relate to a comparatively small and unimportant part of experience, and has entirely overlooked those which are much more vitally important, thus:

"What, for instance, shall be said of love that surmounts and sometimes even denies sex; of sex that defeats procreation? What shall be said of art which fulfils no useful purpose; of laughter that mocks usefulness? How can the heroism that scorns survival be justified? What kind of a case can be made out for the thirst for knowledge for its own sake, the yearning search for meanings beyond the proximate? What shall be thought of the worship that feeds on an ineffable ecstacy; the peace that passes understanding? These are the major and most imperative aspects of experience, yet the scientific cosmology gives them scant notice."

This is perhaps a little overdrawn, and not quite fair to men of science, many of whom are making the most strenuous efforts to gain some insight into the reality and significance of values. It is also probably grossly unfair to hold the scientific cosmology responsible for all the ills of industrialism, or for the insensate worship of bigness in buildings, skyscrapers, super-dirigibles, etc. Many of these things have been evolved under the stress of modern competition, or on the clearer realisation of the fact that better results from every point of view can be obtained from big things than from small. They are not inherently or necessarily bad; nor are they often worshipped; nor were they deliberately foreseen and designed by the man of science.

Apart, however, from possible overstatement here, and a little obscurity there, the book may be said to offer, in this all-important and difficult search for values, some useful clues both on philosophical and scientific grounds; and it is not perhaps too much to say that it goes far in giving us a line of approach to a reasoned faith and theory of life that may clear up some of our doubts and difficulties. There is some trenchant criticism of the present scientific cosmology, which is held to have been constructed on exceedingly dubious and unverified metaphysical principles, deduced from a misinterpretation of what science has discovered. The authors attack it mercilessly, and substitute in its place their own metaphysic based entirely on human values; and they strenuously deny that science itself is built up on demonstrable fact. Indeed they seek to remove the "absurd halo" from science, put human values back into their rightful place, and remove the curse from matter—an ambitious programme valiantly

attempted, and perhaps, so far as the halo is concerned, achieved.

The book is well written, eminently readable for the most part, though difficult in places, concise rather than diffuse, strong and vigorous in movement, even with flashes of eloquence, and a constant appeal to reality and experience which keeps one fairly steadily on the ground, though mentally some exhilarating flights are taken.

W. G. L. C.

The Vertebral Column

The Evolution of the Vertebral Column : a Contribution to the Study of Vertebrate Phylogeny. By Dr. H. F. Gadow. Edited by J. F. Gaskell and H. L. H. H. Green. Pp. xiv+356. (Cambridge: At the University Press, 1933.) 25*s.* net.

IT is now nearly forty years since Dr. Gadow and Miss Abbott published their well-known paper on "The Evolution of the Vertebral Columns" in the *Philosophical Transactions* of 1895–96, the first attempt at tracing a fundamental plan of structure throughout the Vertebrata. In it they maintained that from fish to man the vertebra is built of four primary paired elements surrounding the notochordal axis. Appearing first as cartilages both in ontogeny and in phylogeny, but later often ossified, these elements give rise to the various types of vertebra characteristic of the different groups, some becoming more important, others dwindling or disappearing. A convenient nomenclature was introduced, since very generally adopted: the four elements or arcualia include the basalia and interbasalia ; the former are the basidorsal above (giving rise to neural arch), and the basiventral below (giving rise to hæmal arch, rib and chevron); the interbasalia, which alternate with them, are the interdorsal above and interventral below. But, simple and illuminating as this scheme appears to be, it has not met with general acceptance, perhaps because it was to some extent founded on an erroneous interpretation of the development of the arcualia, of their derivation from the sclerotomes out of which they are formed, and of their relation to the muscle segments with which the vertebræ come to alternate in the adult. Much work has been done since then by palæontologists and embryologists on the vertebral column, and there can be little doubt that, on the whole, it has strengthened the main position taken up by Dr. Gadow and Miss Abbott.

The volume under review contains material unfortunately left unfinished owing to the sudden death of the author in 1928. It has been most ably edited by Messrs. Gaskell and Green, with the help of Mrs. Gadow, who have illustrated it by well-chosen figures from various publications and added useful coloured diagrams.

In this book embodying the author's mature conclusions, Dr. Gadow with admirable frankness corrects his former errors, and brings his scheme into harmony with modern embryology. He thus places his theory on a much firmer basis, and greatly simplifies the account of the relation borne by the arcualia to sclerotomes and myomeres.

It is now generally held that the sclerotome of each original segment becomes divided into anterior (cranial) and posterior (caudal) portions, that in the latter arise the basalia (in front of, and related to, the intermuscular or intersegmental septum), and in the former arise the interbasalia; and, further, that since, in Tetrapods at least, the interbasalia tend to become attached to the basalia of the segment in front, each completed vertebra comes to alternate with the muscular segments.

The book is chiefly concerned with the Tetrapoda or four-footed land vertebrates, and, after the introductory general chapters, there is a useful description of the chief processes developed on their vertebræ, their articulations and nomenclature. Next comes a discussion of the atlas, epistropheus and the illusive 'proatlas' sometimes found between skull and vertebral column. With regard to the proatlas, Gadow concludes, we think rightly, that it represents the interdorsal elements of the atlas sclerotome. Here we may remark that it seems undesirable to apply the term epistropheus to the second vertebra of the Amphibia, where we miss the special modification and combination of the first and second vertebræ so characteristic of the Amniota.

The remainder of the book contains definitions of the various types of vertebra found in Tetrapods, and descriptions of the vertebral columns of the different groups. It may be noticed that Gadow adheres to his former statement that the so-called 'notochordal cartilage' occurring in the middle of the vertebra of certain modern Amphibia and Reptilia is formed by the ingrowth through the sheaths of the notochord of cells from the outer mesoblast. This is a matter about which there has been much controversy, but no convincing evidence has so far been brought forward to prove that in

Tetrapods such an invasion of the sheaths takes place.

Readers will perhaps be most interested in Gadow's interpretation of the composition of the vertebra in the Amniota. To trace the fate of the four primary elements from early fossil Stegocephalia to reptile, bird and mammal is a difficult task, more particularly since some of the arcualia are scarcely recognisable in early stages of development in modern forms. Yet it will be generally admitted that, on the whole, Gadow has succeeded in vindicating his position. His general result is that the neural arch is the basidorsal, while the basiventral dwindles or disappears in the trunk to the so-called intercentrum (hypocentrum) or is lost, and that the body of the vertebra is derived from the interventrals. We venture to think, however, that he has attributed too much importance to the interventral and too little to the interdorsal, and that it would be truer to say that the centrum is formed by the interbasals. For example, Piiper in birds, and Dawes in mammals, have recently shown that interdorsals contribute a considerable part.

The important tail region of the column is somewhat neglected in this book, and there is a strange inconsistency on p. 264 dealing with *Sphenodon*, where the chevrons are said to belong genetically to the interventrals. Whether this statement was made deliberately or was due to a slip of the pen it is difficult to say, but it is inconsistent with other statements elsewhere, and with the author's original view (1896). Few conclusions seem more certain than that the chevrons belong to the basiventrals.

Students of comparative anatomy will be grateful for this useful and interesting work by one whose practical knowledge of the details of the anatomy of vertebrates was so great. The exaggerated importance he attributes to Hæckel's recapitulation theory may be easily forgiven in such an important contribution to our knowledge of the vertebral column. The handsome, well-printed and well-illustrated volume will be welcomed as a fitting memorial to an enthusiastic zoologist who devoted his life to the study of the comparative anatomy of the Vertebrata.

E. S. G.

Short Reviews

Oberflächenspannung in der Biologie und Medizin. Von Dr. Ferdinand Herčík. (Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe, herausgegeben von Dr. Raphael Ed. Liesegang, Band 32.) Pp. xii+220. (Dresden und Leipzig: Theodor Steinkopff, 1934.) 14 gold marks.

THIS book will probably be found disappointing by both physical chemists and biologists. It begins with a few brief notes on the nature of surface tension, too sketchy to give any clear idea of the physical nature of this quantity. The section on measuring surface tension shows the author as a devotee of the unreliable 'ring' method, which is starred so prominently that the three principal illustrations in the book are portraits of different forms of torsion balance for operating the method. Although Harkins's careful studies of its errors, and corrections therefor, are mentioned, they do not appear to be taken seriously. The drop volume and bubble pressure methods are the only others described, and there is no real appreciation of either their possibilities or their errors. There is a rather more satisfactory account of the influence of physical factors on the surface tension of pure liquids and solutions; but the fine structure of surface films, and also electrocapillarity, are mentioned but dismissed with an entirely superficial and out-of-date treatment. There is little understanding of the relation between chemical constitution and surface properties. In this field, the author makes little reference to recent work except that of du Noüy and his co-workers.

The rest of the book contains abstracts of work on the surface tension of various body fluids in physiological and pathological conditions—as the changes noted often amount to only one or two dynes per centimetre, many of them may be accidental errors of measurement; and references to views held or suggested, with more or less foundation, by numerous workers as to the importance of surface tension in cell division, growth, muscular and amœboid movement, narcosis and action of vitamins. This may be useful as a rough introduction to the biological literature; but the book is far from being *au fait* with modern surface chemistry, and still farther from being a trustworthy guide to the application of this science to biology.

N. K. A.

Mineral Deposits. By Prof. Henry Louis. Pp. viii+384+3 plates. (London: Ernest Benn, Ltd., 1934.) 30*s*. net.

IN the preface of this book, the author states that miners are but little concerned with the genesis of mineral deposits, and that as the book is intended for use by miners, he has dealt in only the most perfunctory fashion with the mode of formation of mineral deposits. In chaps. ii to x, however, which make up the greater part of the book, deposits are classified according to their mode of origin, a procedure which requires that

the reader should have some knowledge of the formation of rocks.

The two main divisions adopted in the above-mentioned chapters are Symphytic (bedded) deposits and Epactic (non-stratified) deposits. The symphytic deposits are grouped as clastic, chemical, organic and stratified. The epactic deposits are grouped as veins, masses (stockworks and igneous disseminations), magmatic masses and masses connected with soluble rocks.

The author makes the claim for this classification that "the names are genetic, but the underlying characteristics are morphological or tectonic . . . that it corresponds reasonably well with the observed facts, that it answers the practical needs of the miner, that it enables a useful view to be obtained of a very involved subject, and that it is not illogical".

An introductory chapter deals with general matters; chap. xi deals with the alterations of mineral deposits; chaps. xii–xv give an economic classification under headings of fuels, ores, salts and gems; and there are two good indexes, one general, the other geographical.

The book contains much useful information on the subject of mineral deposits; but it may be suggested that future editions should make mention of the diamond deposits in West and Central Africa, Peruvian and other vanadium ore deposits, Belgian Congo and other radium mineral deposits and Chinese tungsten ore.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By Dr. J. W. Mellor. Vol. 13: *Fe* (Part 2). Pp. ix+948. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 63*s*. net.

VOL. 13 of Mellor's "Comprehensive Treatise" is devoted exclusively to the element iron, which has already formed the subject of a large part of the preceding volume. The present volume deals first with the mechanical, thermal, optical, electrical and magnetic properties of the metal and of its alloys with carbon. Ample attention is given to slip bands, Smekal cracks, transition temperatures, absorption, emission and X-ray spectra. The chemical properties of iron, the corrosion of iron and steel, and the passivity of iron, form the subjects of the next three sections. A full report is given of modern work on this group of subjects, which has given rise to much controversy in recent years; and the clarifying experiments and theories of U. R. Evans on corrosion and passivity are adequately described.

The section on the valency and atomic weight of iron only covers three pages, with two pages of references. Two structural formulæ, showing the polymerisation of ferrous and ferric chloride to double molecules by means of double bonds between pairs of chlorine atoms, are efforts of pure imagination on the part of the authors from whose works they are cited, and are of no value at all at the present day; and the view that in iron tetracarbonyl and pentacarbonyl "the iron is bivalent, and that the bivalent carbonyl radicals are arranged in closed chains" is equally obsolete and unjustified by experiment.

The longest section in the volume deals with the alloys and intermetallic compounds of iron. The text is in very condensed form, but the references alone cover 33 closely-printed pages. The remaining sections deal with the oxygen compounds of iron—oxides, hydroxides, ferrites, ferrates, etc.

The Electrical Properties of Glass. By J. T. Littleton and G. W. Morey. (National Research Council Committee on Electrical Insulation, Monograph No. 3.) Pp. x+184. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 18*s*. 6*d*. net.

THIS monograph is issued under the auspices of the American National Committee on Electrical Insulation and discusses the electrical insulation of glass; the insulation of liquids and gases has been discussed in two other monographs. Very little definite knowledge has been previously published showing the connexion between the electrical properties of glass and its composition. The present volume gives a wide survey of the theoretical progress that has been made and critically reviews the available information. It will prove useful to students of the insulating properties of solid dielectrics, as glass is a very convenient material on which to experiment. It is widely used as an engineering material, and so a knowledge of its limitations will be helpful to engineers. Unfortunately, the results obtained by experimenters do not always agree. Defining the electric strength of glass as the maximum voltage gradient required to puncture the material, it would appear to be a variable depending on the thickness of the test specimen. This point needs further experimental investigation.

I Grandi Problemi della Biologia Generale. Per Camillo Acqua. (Biblioteca di Scienze e Filosofia, N. 6.) Pp. viii+253. (Roma: G. Bardi, 1933.) 18 lire.

THIS book consists of a series of essays on the fundamental problems of biology. The essays, however, form a connected discussion of these problems, in which the basic facts are given and modern ideas and theories are reviewed. The treatment is clear and interesting. There are neither figures nor index, but the general subjects of the various chapters are subdivided, so that the list of contents gives a good idea of the matter treated. The principal problems discussed are the origin of life, the differentiation of the plant and animal kingdoms, sex, parthenogenesis, death, Lamarckism, Darwinism, heredity, Mendelism, the gene, mutations and the evolution of species. The author makes a point of carefully separating the known facts from theories and hypotheses, and the result is an illuminating and suggestive volume.

A 'Nuclear Photo-effect': Disintegration of the Diplon by γ-Rays

By DR. J. CHADWICK, F.R.S., and M. GOLDHABER

BY analogy with the excitation and ionisation of atoms by light, one might expect that any complex nucleus should be excited or 'ionised', that is, disintegrated, by γ-rays of suitable energy. Disintegration would be much easier to detect than excitation. The necessary condition to make disintegration possible is that the energy of the γ-ray must be greater than the binding energy of the emitted particle. The γ-rays of thorium C″ of $h\nu = 2 \cdot 62 \times 10^6$ electron volts are the most energetic which are available in sufficient intensity, and therefore one might expect to produce disintegration with emission of a heavy particle, such as a neutron, proton, etc., only of those nuclei which have a small or negative mass defect; for example, D^2, Be^9, and the radioactive nuclei which emit α-particles. The emission of a positive or negative electron from a nucleus under the influence of γ-rays would be difficult to detect unless the resulting nucleus were radioactive.

Heavy hydrogen was chosen as the element first to be examined, because the diplon has a small mass defect and also because it is the simplest of all nuclear systems and its properties are as important in nuclear theory as the hydrogen atom is in atomic theory. The disintegration to be expected is

$$ {}_1D^2 + h\nu \rightarrow {}_1H^1 + {}_0n^1 \quad \ldots\ldots\ldots \quad (1). $$

Since the momentum of the quantum is small and the masses of the proton and neutron are nearly the same, the available energy, $h\nu - W$, where W is the binding energy of the particles, will be divided nearly equally between the proton and the neutron.

The experiments were as follows. An ionisation chamber was filled with heavy hydrogen of about 95 per cent purity, kindly lent by Dr. Oliphant. The chamber was connected to a linear amplifier and oscillograph in the usual way. When the heavy hydrogen was exposed to the γ-radiation from a source of radiothorium, a number of 'kicks' was recorded by the oscillograph. Tests showed that these kicks must be attributed to protons resulting from the splitting of the diplon. When a radium source of equal γ-ray intensity was employed, very few kicks were observed. From this fact we deduce that the disintegration cannot be produced to any marked degree by γ-rays of energy less than $1 \cdot 8 \times 10^6$ electron volts, for there is a strong line of this energy in the radium C spectrum.

If the nuclear process assumed in (1) is correct, a very reliable estimate of the mass of the neutron can be obtained, for the masses of the atoms of hydrogen and heavy hydrogen are known accurately. They are 1·0078 and 2·0136[1] respectively. Since the diplon is stable and can be disintegrated by a γ-ray of energy $2 \cdot 62 \times 10^6$ electron volts (the strong γ-ray of thorium C″), the mass of the neutron must lie between 1·0058 and 1·0086; if the γ-ray of radium C of $1 \cdot 8 \times 10^6$ electron volts is ineffective, the mass of the neutron must be greater than 1·0077. If the energy of the protons liberated in the disintegration (1) were measured, the mass of the neutron could be fixed very closely. A rough estimate of the energy of the protons was deduced from measurements of the size of the oscillograph kicks in the above experiments. The value obtained was about 250,000 volts. This leads to a binding energy for the diplon of $2 \cdot 1 \times 10^6$ electron volts, and gives a value of 1·0081 for the neutron mass. This estimate of the proton energy is, however, very rough, and for the present we may take for the mass of the neutron the value 1·0080, with extreme errors of ± 0·0005.

Previous estimates of the mass of the neutron have been made from considerations of the energy changes in certain nuclear reactions, and values of 1·007 and 1·010 have been derived in this way[2,3]. These estimates, however, depend not only on assumptions concerning the nuclear processes, but also on certain mass-spectrograph measurements, some of which may be in error by about 0·001 mass units. It is of great importance to fix accurately the mass of the neutron and it is hoped to accomplish this by the new method given here.

Experiments are in preparation to observe the disintegration of the diplon in the expansion chamber. These experiments should confirm the nuclear process which has been assumed, and therewith the assumption that the diplon consists of a proton and a neutron. Both the energy of the protons and their angular distribution should also be obtained.

If, as our experiments suggest, the mass defect of the diplon is about 2×10^6 electron volts, it is at once evident why the diplon cannot be disintegrated by the impact of polonium α-particles[4]. When an α-particle collides with a nucleus of mass number M, only a fraction $M/(M+4)$ of the kinetic energy of the α-particle is available for disintegration, if momentum is to be conserved. In the case of the diplon, therefore, only one third of the kinetic energy of the α-particle is available, and this, for the polonium α-particle, is rather less than $1 \cdot 8 \times 10^6$ electron volts. The more energetic particles of radium C′ should just be able to produce disintegration, and Dunning[5] has in fact observed a small effect when heavy water was enclosed in a radon tube.

Our experiments give a value of about 10^{-28} sq. cm. for the cross-section for disintegration of a diplon by a γ-ray of $2 \cdot 62 \times 10^6$ electron volts. In a paper to be published shortly, H. Bethe and R. Peierls have calculated this cross-section,

assuming the interaction forces between a proton and a neutron which are given by the considerations developed by Heisenberg, Majorana and Wigner. They have obtained the transition probability in the usual quantum-mechanical way, and their result gives a value for the cross-section of the same order as the experimental value, but rather greater, if we take the mass of the neutron as 1·0080. If, however, we take the experimental value for the cross-section, the calculations lead to a neutron mass of 1·0085, which seems rather high. Thus the agreement of theory with experiment may be called satisfactory but not complete.

One further point may be mentioned. Some experiments of Lea[6] have shown that paraffin wax bombarded by neutrons emits a hard γ-radiation greater in intensity and in quantum energy than when carbon alone is bombarded. The explanation suggested was that, in the collisions of neutrons and protons, the particles sometimes combine to form a diplon, with the emission of a γ-ray. This process is the reverse of the one considered here. Now if we assume detailed balancing of all processes occurring in a thermodynamical equilibrium between diplons, protons, neutrons and radiation, we can calculate, without any special assumption about interaction forces, the relative probabilities of the reaction (1) and the reverse process. Using our experimental value for the cross-section for reaction (1), we can calculate the cross-section for the capture of neutrons by protons for the case when the neutrons have a kinetic energy $2(h\nu - W) = 1 \cdot 0 \times 10^6$ electron volts in a co-ordinate system in which the proton is at rest before the collision. In this special case the cross-section σ_c for capture (into the ground state of the diplon—we neglect possible higher states) is much smaller than the cross-section σ_p for the 'photo-effect'. It is unlikely that σ_c will be very much greater for the faster neutrons concerned in Lea's experiments. It therefore seems very difficult to explain the observations of Lea as due to the capture of neutrons by protons, for this effect should be extremely small. A satisfactory explanation is not easy to find and further experiments seem desirable.

[1] K. T. Bainbridge, *Phys. Rev.*, **44**, 57; 1933.
[2] J. Chadwick, *Proc. Roy. Soc.*, A, **142**, 1; 1933.
[3] I. Curie and F. Joliot, NATURE, **133**, 721, May 12, 1934.
[4] Rutherford and A. E. Kempton, *Proc. Roy. Soc.*, A, **143**, 724; 1934.
[5] *Phys. Rev.*, **45**, 586; 1934.
[6] NATURE, **133**, 24, Jan. 6, 1934.

Ancient Indian Iron

By S. C. BRITTON, Salters Fellow, University Metallurgical Laboratories, Cambridge

IT appears certain that iron was known in India at a very early date. Mention of its production in ancient writings puts the earliest time of production earlier than 1,000 B.C. According to Herodotus[1], the Indian contingent of the army of Xerxes were using iron for military purposes about 500 B.C. The description of iron surgical instruments in an ancient medical work, the excavation of iron weapons from burial sites and the presence to this day of masses of iron like the pillars of Delhi and Dhar all indicate that the production of iron steadily increased as the centuries passed.

The methods of production and qualities of Indian iron and steel seem to have early excited the curiosity of the British conquerors and in 1795, Dr. George Pearson[2] published a paper on a kind of steel named 'wootz', then being manufactured in Bombay. The methods of analysis and examination then available only allowed the vague conclusions that the metal was very hard, had about 0·03 per cent carbon, and was believed to have been produced by direct reduction of the ore. Dr. Buchanan's "Travels in the South of India", published in 1807, describes the native Indian processes for iron and steel production then employed, which were believed to be those handed down from previous ages. Numerous other investigations have been made since that time, which increase in thoroughness as methods of examination have improved.

THE DELHI PILLAR

The Delhi pillar has constantly aroused interest. Sir Alexander Cunningham, in the "Archæological Survey of India", published during the years 1862–65, reported the pillar as a solid shaft of wrought iron, upwards of sixteen inches in diameter and twenty-two feet in length; he mentions the curious yellow colour of the upper part of the shaft, which at one time caused the belief that the pillar was of bronze. This appearance has been commented upon by many observers since that time. Inscriptions made on the pillar are said still to be perfectly clear and sharp, and these have allowed the approximate date of its erection to be fixed as A.D. 310.

There seems little doubt that the pillar was built up by welding together discs of iron; it is said that the marks of welding can still plainly be seen[3]. Sir Robert Hadfield examined a small specimen of the pillar in 1911 and afterwards was able to make a fairly detailed investigation of a larger piece[4]. The analysis showed the composition C, 0·08; Si, 0·046; Mn, 0; P, 0·114; N, 0·032: Fe, 99·72; Cu and other elements, 0·034. Hadfield described the iron as an excellent type of wrought iron entirely free from inclusions, being better from the point of view of homogeneity and purity than the best modern Swedish charcoal irons. The structure was found to consist of large grains of ferrite with a very small portion of cementite, sometimes located in the grain boundaries and

occasionally in the ground mass. A smaller grain structure, independent of the large one, was faintly visible, and there were also a large number of small lines in a regular formation which appeared to be related to the small grain structure; this was mentioned as possibly due to an aging effect. A specimen of the pillar rusted in a single night when water was placed on it in Hadfield's laboratory, but the fractured surface suffered no change in four days when merely exposed to the laboratory atmosphere[5]. Hadfield mentions that the part of the pillar below the ground had suffered from corrosion.

The Dhar Pillar

The great iron pillar found at Dhar is described in detail by Cousins[6]. The pillar is in three portions, having apparently been fractured during religious disturbances in the fourteenth and fifteenth centuries A.D. There are no original inscriptions on the pillar itself, or sufficiently definite references elsewhere, to give a basis for any but the vaguest conjecture about the date of manufacture. Its form suggests that it belongs to the Gupta period (A.D. 320–480), and the general belief is that it is approximately contemporaneous with the Delhi pillar.

The original Dhar pillar appears to have been approximately 50 feet long with an average section of 104 square inches and a weight of about 7 tons, and, like the Delhi pillar, it seems to have been constructed by welding together discs of wrought iron. There are a number of holes in the pillar of about $1\frac{1}{4}$ in. diameter and varying from $1\frac{3}{4}$ in. to 3 in. in depth, which Cousins[6] suggests were intended to hold tommy-bars for turning the mass whilst it was being forged; the finding of the broken end of a bar jammed into one of the holes lends some support to this idea. Sir Robert Hadfield has examined a specimen of the pillar[7], and found it to be wrought iron having C, 0·02; P, 0·28; Fe, 99·6. The Brinell ball hardness varied considerably and irregularly over the material, the limits being 240 and 121; the fracture was bright and crystalline, showing laminations. Further analyses and micrographical investigation by C. J. Smithells and by Prof. Cobb have shown no new features in the iron; it is found to rust fairly quickly in a laboratory atmosphere[8].

Ancient Sinhalese Iron

The first thorough investigation of ancient Indian steel was made by Sir Robert Hadfield in 1911–12[9]. He was able to examine a number of ancient implements which had been excavated from the buried cities of Ceylon. Many such implements have been unearthed; they are very heavily rusted and apparently continue to rust in the atmosphere of the Museum of Colombo, unless very carefully protected. Nevertheless, the presence of a considerable quantity of yet unchanged iron shows a marked resistance to corrosion. An ancient Sinhalese chisel, dating back to the fifth century, was found to have the percentage composition, iron, 99·3; phosphorus, 0·28; sulphur, 0·003; silicon, 0·12; no manganese and only traces of carbon with about 0·3 per cent of slag and oxide inclusions. Examination of micro-sections led Hadfield to believe that the chisel had been carburised, had originally been quenched, but had become partially tempered during the long lapse of time. A nail and an ancient billhook of similar age and origin showed a similar analysis. All the specimens contained a large amount of slag in lumpy irregular form. The low sulphur content was held to indicate that the metal was originally produced by charcoal reduction of the ore. The microscopical examination suggested that the specimens were rather similar to modern puddled iron, and this was further borne out to some extent by mechanical tests.

The Iron Beams at Konarak

A number of large iron beams which were apparently used in the construction of the collapsed Black Pagoda at Konarak are still lying amid the ruins of the temple in varying states of preservation. The date most generally accepted for the building of the temple is about 1240 A.D., and it is presumed that the beams were made at that time. Their appearance is fully described by Graves[10].

There are some twenty-nine massive bars, most of them broken in the collapse of the building; the largest two are approximately 35 feet long by about 8 inches square and $25\frac{1}{2}$ feet long by 11 inches square respectively. They show very definite evidence of having been fabricated by welding up small blooms, commonly 2 inches by 1 inch in section and 6 inches long. Many of the broken ends show the existence of irregular and sometimes uniform cavities from which small pieces of cinder can be raked. Some of the beams are very heavily rusted, but many of them are scarcely affected and have a very thin and closely adherent coating. A specimen taken from one of the beams has been examined by Friend and Thornycroft[11]. The presence of many cracks, containing slag inclusions, rendered micrographical investigation difficult. The cracks were found to be bordered by bands of ferrite, the grain boundaries being faintly discernible. Portions of the specimen more distant from the cracks showed a fairly uniform structure, typical of a mild steel containing rather less than 0·15 per cent carbon. The metal was found to be very soft, having a Brinell hardness number of 72. Analysis of a piece chosen as free from slag showed C, 0·110; Si, 0·100; S, 0·024; P, 0·015; Mn, a trace.

An attempt was made to compare the resistance to corrosion of the metal with that of a modern mild steel of unspecified composition. One weighed specimen of each was exposed to alternate wetting by tap-water and drying for one year; reweighing

after removal of rust showed that the ancient iron had suffered a loss amounting to 89 per cent of that of the modern steel. The specimens were then exposed to the action of an artificial sea-water for a year and again the ancient iron lost less weight than the modern steel, losses being in the ratio 75 : 100. However, tests of this kind, made on single specimens, and including only one modern steel, really show very little about the corrosion resistance of the ancient metal.

Miscellaneous Specimens

The so-called Pillar of Heliodorus at Besnagar, which is itself of stone, is supported at its base by iron wedges which are still in a partial state of preservation. It is believed that the pillar was erected about 125 B.C. and that the iron supports were used from the outset. However, there is a possibility that the metal was not native India iron, but was imported from Greece. Hadfield has examined a sample of it and describes it[12] as the only ancient ferrous specimen which can be called steel; he actually demonstrated that it could be hardened by quenching. The structure was pearlitic, having elongated and irregularly disposed crystals of sorbitic pearlite upon a ferrite ground mass; after quenching from 850° C. in water, a specimen became martensitic. There were seams of slag in some portions. Analysis showed C, 0·70; Si, 0·04; S, 0·008; P, 0·020; Mn, 0·02; Cr, a trace; Fe, 99. The Brinell hardness number was 146.

W. Rosenhain[13] mentions ancient iron chains which assisted pilgrims to climb Adam's Peak, Ceylon. These have been worn round and smooth, but are apparently uncorroded. Rosenhain suggested that the links have corroded down to a cinder layer so that the outside remaining is apparently only a cinder surface protecting the iron below; specimens cut and brought to London rusted as quickly as any other iron. Graves[14] gives a list of 239 pieces of iron ranging up to 17 feet long and up to 6 inches by 4 inches section used in the construction of the Garden Temple at Puri, which was built not later than the first half of the twelfth century. However, no further information on these is available.

Iron swords and daggers of uncertain date have been unearthed from burial sites in the district of Tinnevelly and specimens of third century iron have been recovered from Buddha Gaya[15] but no examination appears to have been made.

It seems possible that many specimens of iron exist in India of which the date of manufacture cannot be established, but which may well be ancient, and there are no doubt others of ascertainable date yet to be excavated from the earth.

[1] Book VII, chapter 65.
[2] *Phil. Trans.*, **112**, 253.
[3] Turner, *J. Iron and Steel Inst.*, **85**, 184; 1912.
[4] *J.I.S.I.*, **122**, 240; 1925.
[5] *J. Soc. Chem. Ind.*, **44**, 1029; 1925.
[6] "Annual Report of the Archæological Survey of India, 1902–3", p. 205.
[7] Discussion of a paper by T. A. Rickards, *J.I.S.I.*, No. II, 345; 1929.
[8] Prof. A. Smithells, private communication, April 1934.
[9] *J.I.S.I.*, No. 1, 312; 1912.
[10] *J.I.S.I.*, **85**, 187; 1912.
[11] *J.I.S.I.*, No. II, 313; 1924.
[12] *Trans. Far. Soc.*, (10), 210; 1914.
[13] *Trans. Far. Soc.*, **11**, 236; 1916.
[14] *J.I.S.I.*, No. 1, 199; 1912.
[15] Friend, "Iron in Antiquity", p. 142.

(*To be continued.*)

Samuel Pierpont Langley (1834–1906)

On August 22, the centenary of the birth of Samuel Pierpont Langley will be commemorated at the Smithsonian Institution, Washington. Langley was secretary of the Institution from 1887 until 1906; it was there he made his valuable investigations in aeronautics and to him was due the inauguration of both the Astrophysical Observatory and the National Zoological Park, which, like the United States National Museum and the Bureau of American Ethnology, are integral parts of the Institution. Much of his experimental apparatus is preserved in the Museum, and it has accordingly been arranged for a special exhibit devoted to his activities and honours to be unveiled on the hundredth anniversary of his birth. The exhibit is being arranged by Mr. T. T. Belote, curator of the Division of American History, and it will ultimately be one of four recalling his own work and that of his two predecessors, Joseph Henry, who was secretary from 1846 until 1878, and Spencer Fullerton Baird, who held the office from 1878 until 1887, and of his successor, Charles Doolittle Walcott, who was secretary from 1907 until 1927. It is also intended to direct attention to Langley's work in the Press, and to publish a special memoir of him containing some extracts from his writings.

Langley was born at Roxbury, Massachusetts, on August 22, 1834, and died at the age of seventy-one years on February 27, 1906, at Aiken, South Carolina. The son of a wholesale merchant of Boston, he came of a family connected with many of the most eminent men in the history of Massachusetts, and grew up in an atmosphere which stimulated his original and inquiring mind. Even as a mere child, he had the use of a telescope, and he once declared that he could not remember when he was not interested in astronomy. Like all the family, he was an omnivorous reader and when, as a youth of seventeen years, he left the Boston High School, he had laid the foundation of his knowledge of English, French and German classics. On leaving school he took up civil engineering and architecture, and at the age of twenty-three years went westward, spending seven years in Chicago and St. Louis. Of this

phase in Langley's career, his biographers say very little.

The turning point in Langley's career came when he was thirty-one years of age. Following a tour in Europe, during which he visited many scientific institutions and observatories, he abandoned practical engineering for astronomy, and although without any academic standing, in 1865 he became an assistant in Harvard Observatory. In the following year he joined the Naval Academy at Annapolis as an assistant professor of mathematics and in 1867 was appointed director of the Allegheny Observatory and professor of physics in the Western University of Pennsylvania, Pittsburgh, where he remained twenty years. To this period belongs his important researches on the sun which brought him fame both at home and abroad. He took part in total solar eclipse expeditions to Kentucky in 1869, to Spain in 1870, and to Pike's Peak in 1878, and a year or two later invented the bolometer, an electrical resistance thermometer of extreme delicacy. With this he was able to explore the infra-red portion of the sun's spectrum, and after experiments at Allegheny, with his assistant James Edward Keeler (1857–1900), afterwards director of Lick Observatory, made an expedition to Mount Whitney, California, where at a height of 14,887 ft. "in the driest and purest air, perhaps in the world . . . the known extent of the solar spectrum was thus at once more than doubled". While at Allegheny he also had a large share in inducing the railway companies to adopt the system of standard time now in use, and likewise became known as a lecturer and writer able to present difficult and abstruse subjects in language at once lucid and entertaining.

Many honours came to Langley through his study of solar radiation, and by the age of fifty years he had gained an international reputation. His connexion with the Smithsonian Institution began in January 1887, when he was appointed assistant secretary and placed in charge of the library and international exchanges. In that year he also served as president of the American Association for the Advancement of Science, and in November, on the death of Baird, was made secretary of the Smithsonian Institution. Though somewhat hampered by want of funds, with money from private sources he was able to establish the Astrophysical Observatory, and after three years of effort on his part, in 1890 Congress made an appropriation of 200,000 dollars for the purchase of 167 acres of land near Washington for a National Zoological Park.

The outstanding feature of Langley's life's work at Washington, however, was his devotion to the infant science of aeronautics, which then had many more sceptics than students. Like the experiments of his contemporaries—Lilienthal in Germany, Hargrave in Australia, Ader in France, and Maxim in England—Langley's investigations were made in comparative isolation and at the time attracted but little attention. Speaking in 1922, long after the aeroplane had become a commonplace, Prof. L. Bairstow referred to Langley's work as "a first rate example of systematic inquiry. . . . Progress was made step by step in the face of formidable difficulties, and no attempts were made to solve the problems of mechanical flight by bursts of brilliance or invention".

Langley's successful experiments with model aeroplanes are now well known, but there is another important aspect of his work. This is referred to in the sketch of Langley given in the "Dictionary of American Biography" now being published under the auspices of the American Council of Learned Societies. "The greatness of his contribution to aviation," the writer says, "depends not only on his pioneering laboratory investigations and successful long-distance flights of large power-driven models, but on the very fact that a man of his reputation should have adventured it in a field at that time so much ridiculed." The development of aviation was largely determined by his efforts, and the Wright brothers wrote that "the knowledge that the head of the most prominent scientific institution of America believed in the possibility of human flight was one of the influences which led us to undertake the preliminary investigations that preceded our active work".

The first fruits of Langley's laboratory investigations were given in his "Experiments in Aerodynamics" published in 1891 and "The Internal Work of the Wind" of 1893. Having discovered some of the fundamental principles underlying the design of heavier-than-air flying machines, he proceeded to construct power-driven models. After using twisted rubber and wound-up springs for driving the propellers, he constructed petrol-heated flash-boiler steam engines weighing about 5 lb. per horse-power. His models he called "aerodromes", and on May 6, 1896, at Quantico on the Potomac, Aerodrome No. 5 flew some 3,000 ft. Six months later, on November 28, No. 6 flew 4,200 ft. These were the first sustained free flights of power-driven heavier-than-air machines ever made. Writing of what he had accomplished, Langley said a year or two later: "I have brought to a close the portion of the work which seemed especially mine—the demonstration of the practicability of mechanical flight—and for the next stage, which is the commercial and practical development of the idea, it is probable that the world may look to others. The world, indeed, would be supine if it does not realise that a new possibility has come to it, and that the great universal highway overhead is now soon to be opened."

It does not appear from Langley's writings that he anticipated constructing a full-size aeroplane, but he was one of those who find themselves "in the river of the thoughts and events, forced onward by the ideas and necessities of his contemporaries". Through the suggestion of some American naval and military officers, the War

Department Board of Ordnance in 1898, during the presidency of Mr. McKinley, secured an appropriation of 50,000 dollars for the building of a man-carrying machine, and Langley at the age of sixty-four years found himself committed to a task which might well have daunted far younger men. As before, the power unit proved one of the greatest difficulties, but this problem was solved by the brilliant young inventor Charles Matthew Manly (1876–1927), who had been recommended to Langley by Prof. Thurston. After several attempts, Manly produced the five-cylinder radial petrol engine, now preserved at Washington, which was used in the abortive trials of 1903. The engine with its accessories weighed 187·47 lb. and developed 52·4 h.p. at 950 r.p.m. Manly was also the pilot on the trials of October 7 and December 8, 1903, and on both occasions narrowly escaped drowning.

The failure of those trials was undoubtedly a great disappointment to Langley, but in the opinion of many well qualified to judge, only a little more good fortune would have secured for the Langley machine the record established a few days later at Kitty Hawk by the machine of Wilbur and Orville Wright. Of the trials of Langley's machine made in 1914 over Lake Keuka, at Hammondsport, New York, by Glenn Curtiss, some observations were made in NATURE of November 3, 1921, January 26, and March 9, 1922, and it is unnecessary to repeat them here. Langley had passed away many years before those trials, leaving behind him a remarkable record of sustained effort and steady achievement, and of undiminished faith in the future of aviation. His record is indelibly inscribed in both the history of the study of the heavens and the story of the conquest of the air.

The Loch Ness "Monster"

SINCE our earlier notes upon this subject were written (NATURE, Jan. 13, 1934, p. 56), the attention of thousands of people has been concentrated upon seeing and adding to the descriptions of this world-famous animal. The situation is without parallel in the records of the observation of Nature, and it is of some interest to analyse the results.

Clearly the recent records are not all of equal value. On July 4, a worker at Glendoe sawmill (as reported in the *Scotsman*, July 7) observed the creature emerge from the loch: as it emerged propelled by flippers, five humps were seen, twelve distinct humps as it wormed its way ashore, head smaller and thicker than a horse's, neck heavily maned, body fully 30 feet long, but not very thick. It was seen to feed upon weeds and water plants growing on the shore (a previous observer had seen it or another carrying a lamb in its mouth) and as the monastery clock struck 10 a.m., it wriggled back into the loch, having been under observation for an hour. A drawing representing this apparition accompanied the newspaper account.

In a different category must be placed the photograph, by Dr. R. K. Wilson, reproduced in the *Daily Mail* of April 21, of a long neck with small head projecting from the loch at a distance of 150–200 yards from the camera. The difficulty in this case is to convince oneself that the object photographed is a head and neck, and is moving—the indications on the water surface suggest rather a stationary object.

Undoubtedly the most thorough series of observations is that due to the organisation of Sir Edward Mountain, who for four weeks, just concluded, has had twenty watchers posted at points of advantage on the shores of Loch Ness. They report having seen the creature twenty-one times and have made five photographs. Three of the photographs, presumably the better ones, have been reproduced in different newspapers. Of these, one shows the wash of an object, probably bulky and moving at considerable speed, but of the object itself nothing. A second shows a very low dark 'hump' or perhaps two, but in the reproduction, lines, less marked, seem to be continued in both directions from the dark object, and a moving object does not make a wash in opposite directions. Even if this represents something animate, the something is indeterminate. The third reproduction (in the *Scotsman*) is more definite, showing something short and fairly massive, low in the water, succeeded by two or three less distinct 'humps'. It is impossible to say what it is, but it suggests to the writer the appearance of the head of a large seal, and the 'humps' water ripples caused by shoulders and hind quarters. Of the twenty-one reports, all that the published accounts (*Times* and *Scotsman*, August 9) say is that "in the main . . . the watchers agree that when on the surface the monster displays a very small head relative to the size of the body, and moves along the water in such a way as to show either two or three humps".

We write with the disadvantage of not having examined the negatives or the actual reports of Sir Edward Mountain's watchers (who presumably are untrained in the observation of animal ways), but keeping in mind that any creature of marine habit transported to fresh water, will lie low in the water and so lose some of its usual appearance, we do not yet find it necessary to depart from our earlier suggestion that the monster may be a large grey seal. The great difficulty is to account for the frequent descriptions of a small head on a long neck, but the reproduction in the *Scotsman* does not suggest a very small head (if the anterior portion showing is the head) and the summary of the observations of Sir Edward Mountain's watchers makes no mention of a long neck.

J. R.

Obituary

Prof. H. F. W. Burstall

Henry Frederick William Burstall, who died on July 15, was born in Aberdeen on September 3, 1865, but he was not of Scottish descent nor had he any Scotch accent. As a boy he was weakly, and in consequence his school life suffered many interruptions. At the age of sixteen years he was apprenticed to John Stewart and Son, marine engineers, of Blackwall, and it was during this period that his mathematical ability began to be evident. On the completion of his indentures he entered University College, London, where he attended the lectures of Prof. M. Hill and won a bursary to St. John's College, Cambridge. Three years later he emerged as sixteenth in Part I of the Tripos, and although in Part II ill-health again hampered him, he succeeded in securing a high place in the second class.

From Cambridge in 1890 Burstall went to the late Sir Alexander Kennedy, serving for a year as an assistant under his own brother, Mr. H. R. J. Burstall, and doing chiefly electrical work. His thoughts, however, were now turning towards the academic side of his profession, and he deliberately chose mechanical rather than electrical engineering, believing that it offered more scope. There was nothing in electrical work but straightforward calculation, he said. He was appointed demonstrator in mechanical engineering at King's College, London, and remained there until 1896, when he was elected to the chair of civil and mechanical engineering at the Mason College, Birmingham.

It was a period of great expansion in Birmingham, and Burstall soon found himself involved in those discussions from which the first of the provincial universities was soon to emerge. The scheme included a great engineering school, and to him was entrusted the duty of outlining its scope and its organisation. Much, it was thought, could be learnt from America, and so Burstall was sent to the United States and to Canada. The essential features of the school as it exists to-day are largely his work. He advised that the Departments of Civil, Mechanical and Electrical Engineering should be separate, and himself became the first holder of the chair established by the late Sir James Chance. A feature of the Mechanical Engineering School (at that time unique) was the use of the power station as a heat laboratory; while the establishment of workshops where, as part of a degree course, practical training could be given right through from pattern-making to fitting, was also an innovation.

Although this work of organisation must have been onerous, Burstall found time also for gas engine research. In 1898 he agreed to act as reporter to the Gas Engine Research Committee which had been established by the Institution of Mechanical Engineers, and the well-known reports of 1898, 1901 and 1908 are largely the work of his hand. From this time onwards, he adopted the internal combustion engine as his special study and became a recognised authority upon its indicator diagram. He wrote little; but his papers on the "Indicating of Gas Engines" (1909) and "The Energy Diagram for Gas" (1911) were regarded as valuable contributions to knowledge.

The outbreak of the War threw new duties upon Burstall. The University became a great hospital, and any work in his department was subservient to the responsibility of keeping the necessary power, heat and light available at all times. Nevertheless, for the Admiralty and for the Air Board he carried out work upon carburation at high altitudes and also upon air-flow. The radiators used upon the 'tanks' in 1918 were the outcome of his investigations. With the advent of peace, he returned to the gas engine and devised his 'optical indicator' (1923), which enabled reliable diagrams to be obtained up to 1,600 revolutions per minute.

In later years, Burstall concerned himself more and more with administrative problems at the University, acting as Dean of the Faculty of Science for five years and for a further five as Vice-principal. His hobby was the cultivation of carnations, in which he was well known as an expert and successful exhibitor. When he retired in 1930, he went to live in a small house at Hopwood, near Alvechurch, where he had a workshop, his beloved carnations and a few sheep. There he acquired a philosophy which led him to declare that engineers had done more harm than good by the development of mechanical processes, and that if he had his time again he would choose a calling less divorced from Nature.

There is no questioning Burstall's intellectual ability. One had only to be in conversation with him for a few minutes to realise his wide interests, his philosophical outlook and his powers of expression. If his life did not seem to fulfil its early promise in the direction of scientific research, we must remember the calls which deflected him from his chosen subject. Not only did these arise at the inauguration of the University, and at the outbreak of War, but domestic sorrow laid upon him also the onus of acting both as father and as mother to the four children who survive him.

W. M. C.

We regret to record the death on August 10 at the age of fifty-four years of Mr. Edwin Ward, director since 1931 of the Royal Scottish Museum. Mr. Ward was appointed to the Art and Ethnographical Department of the Museum in 1901. For two seasons he excavated with Sir Flinders Petrie in Egypt, and later wrote a complete guide to the Egyptological collection of the Museum. Although his earliest and main interest was in Egyptology, his knowledge of armour, coins and pottery was extensive.

News and Views

Safety in Industry

THE annual report of the Chief Inspector of Factories and Workshops for 1933 provides the usual impressive picture of what is too readily passed over even by scientific workers as one of the routine services which Government renders to the community. Despite this efficient and untiring service, however, industry's toll of accidents is high—113,260 as against 106,164 in 1932 and 688 fatalities as against 602. The increase is not entirely attributed to improved trade. The physical and mental deterioration of workers in prolonged unemployment has untoward results when they are again employed, and, even apart from this, there is a distressingly high proportion of accidents caused by carelessness or contempt of known dangers. The report is in part a record of the watch and ward which is kept over industry to eliminate its dangers and maintain the standards and conditions of employment required by law. It reveals, however, that the inspectorate, in discharge of such responsibilities, is being drawn more and more into educational work, both direct and indirect, perhaps even more among the employees than among employers themselves.

IN such educational work, there is an obvious place for scientific workers, but the report indicates also how important are the services which they can render in the development of safety methods, the investigation of industrial diseases, and the dangers inherent in new processes or products. Examples quoted in the report such as silicosis, cancer of the bladder, or the use of dioxan, sufficiently indicate the wide scope for research in the prevention of industrial disease, and the development of safer operating conditions depends as much upon scientific investigation providing the necessary knowledge as upon mechanical ingenuity in its use. Respirators, fire-extinguishers and the detection of small concentrations of toxic gases are other matters in which research is being conducted, sometimes in co-operation with other bodies such as the Chemical Defence Research Department or the Association of British Chemical Manufacturers. Chapters in the report in which the preparation of reliable accident statistics is discussed or the effect of industrial work on the health of women and girls equally illustrate the claim of the work of the inspectorate to be regarded as a fundamental scientific service which assists to place industrial practice on a basis of carefully ascertained facts.

Coloration of Young Tapirs

ALL who are interested in the problems presented by the coloration of young animals, will probably pay an early visit to the Gardens of the Zoological Society of London, to inspect the young Brazilian tapir born there a few days ago. As with the wild swine, the 'porklings' of tapirs are longitudinally striped with white on a dark background, but after a fashion of their own, differing conspicuously in the two species. For the young Brazilian animal presents evidence of a more primitive stage in the distribution of these markings, inasmuch as the spaces between the continuous stripes are partly filled in by rows of spots and dashes representing once continuous stripes. In the Malayan species of the same age these broken bands have vanished. The adults of the two species are no less striking in regard to their coloration. For the Brazilian animal, a forest-dweller, is of a uniform black, while the Malayan is one of the most remarkable to be found among the mammals, for the forepart of the body, including the fore-legs, and the hind-legs as far as the base of the tail, are jet black, while the rest of the body is greyish-white. Observation on the living animal has shown that this is really a singularly effective form of 'concealing coloration', since the animal spends the heat of the day asleep among the great boulders strewn over the floor of dried-up river-beds. To these it comes to bear a striking resemblance, the black areas of the body simulating the shadows and the greyish-white portion the sunlit surfaces of the surrounding masses of rock.

Iron Age Finds in Berkshire

A SERIES of archæological investigations on the Berkshire Downs has been organised by the Newbury Field Club under a scheme for the relief of unemployment. Some interesting finds have been made, of which the most noteworthy is an interment of two horses. The skeletons, which were found with their legs intertwined, according to a report from the *Times* correspondent in the issue of August 13, belong to the large-headed, short-necked and short-legged type of the Iron Age breed represented in modern times by the Exmoor and New Forest ponies. One of the skeletons is said to be exceedingly well preserved, but the other had lost its head. The burial is compared with the Yorkshire chariot burials, which are generally held to belong to the earliest phase of the later, or La Tène, period of the Iron Age. The Berkshire example did not, however, include harness and chariot as in the Yorkshire burials. A few miles west of the horse interment, a bronze age burial also included the remains of a domesticated animal. In this instance the skeleton of a dog was found in association with a human skeleton in the contracted position. Other finds include a fragment of beaker pottery (c. 1800 B.C.), and a Roman copper bracelet, found on the same site as the horse burial, and iron age pottery and an ornamented fragment of a Saxon shield found at Scutchamore Knob, near East Hendred.

Excavations at Maiden Castle

EXCAVATIONS which have been planned to cover three years' work, have been begun on the prehistoric earthwork of Maiden Castle, near Dorchester. The responsibility for the excavation has been undertaken by the Society of Antiquaries, and the field-director is Dr. R. E. Mortimer Wheeler, of the

London Museum. According to a report of the work to date which appears in the *Times* of August 10, it has now become evident that a building unearthed by Mr. A. Cunnington in 1882 and again brought to light by the present operations is a temple and not a villa as was at first believed. It is a Roman building which can be definitely identified as the type of temple peculiar to the Celtic regions of France, Germany and Great Britain during the Roman period. It was square in plan with a raised central shrine and a surrounding verandah. Behind the temple is a little two-roomed bungalow which probably served as the residence of the priest. Near these buildings an interesting discovery was a pit-dwelling cut into the chalk to a depth of more than 10 ft. The sides curve towards the top and originally it was covered with a lid-like roof. The floors of rammed chalk were inserted at various periods and the pit would seem to have been inhabited in the later stages of its history. By the Roman period it was filled up. In cutting through a crossbank dividing off the eastern third of the fortress, in which the temple is situated, pottery and a quern of prehistoric date have been discovered, proving that the hill was occupied as a village before Maiden Castle at its earliest stage came into existence.

Electric Shut-down in London on July 29

A statement has now been issued by the Central Electricity Board on the failure of the supply in south-east and east England on Sunday, July 29. In this the Board refers to the joint report of the engineers of the C.E.B. and the London Power Company. The engineers state that they have explored every avenue which might elucidate the general failure, and in their opinion there is only one cause which could fully explain it. It must have been the breakdown of one of the turbines at the Deptford West Station of the London Power Company. The Board states that the system has always, even on Sunday loading, sufficient margin of plant in operation to make good immediately the loss of the largest station's output to the system, and it has also sufficient spare plant ready to be put into operation to maintain that margin against the unlikely contingency of a second station breaking down; but the Board had not considered what would happen if two major stations shut down simultaneously. The Sunday disposition of the generating plant had not allowed for this contingency. If such an abnormal event had happened on a week day, the arrangement of the plant is such that a widespread failure could have been avoided. The Board is satisfied that such a combination of untoward circumstances is not likely to recur and there need be no apprehension of any such general failure in the future.

Statistics in Economic Planning

In *Planning* of July 17 (16 Queen Anne's Gate, London, S.W.1) emphasis is laid on the importance of settling economic and social problems, so far as possible, by reference to ascertained facts, rather than by the dim light of ancient tradition or with the aid of a flash of alleged inspiration. But if the fact-finding method is to prevail, certain conditions must be first satisfied. It is necessary to have a technique for collecting and publishing accurately and promptly the right information in the right form. Planning essentially consists of organising knowledge, and bringing it effectively to bear on current problems of economics, politics and sociology. Here is one of the most obvious contrasts between planning and *laissez-faire*. *Laissez-faire* assumed a process of automatic and almost unconscious growth. A few inquisitive persons, such as Bagehot, might occasionally inquire how the system worked, and which way it was going; but opinion on the whole was indifferent, if not hostile, to the gathering, publication and use of systematic facts and figures. The intense secrecy and suspicion still so often encountered when such information is required, is a survival of this prejudice. The forces now at work are tending to break down this obscurantism, so that one of the most notable features of the present time is the sudden growth of statistics and information services. In certain directions, however, necessary statistics have barely begun to be provided. There is no adequate index of the huge changes in the structure of society which have occurred in the past twenty years, and are still occurring under our eyes. Large-scale planning demands a vast expansion of statistics and information services. Some expansion is taking place, but it is at present completely unco-ordinated, and there are immense gaps.

Industrial and Agricultural Statistics

The Industrial and Agricultural Research Section of the Royal Statistical Society, formed by the Council in 1933, has just issued its first publication as a supplement to part 2, vol. 97 of the *Journal of the Royal Statistical Society*. The issue will be bi-annual (price 5*s*. each) and the second number will be published at the same time as part 4 of the current volume of the *Journal*. Some indication of the type of problem considered by the Section is obtained from the titles of the papers comprising the first number, which are as follows: "Application of Statistical Methods to Production and Research in Industry", "Statistics in Agricultural Research", "A New Method of Handling Statistical Data", and "Methods of Estimating from Samples the Population Standard Deviation". In addition, an account is given of the formation of the new section, and a bibliography of papers on agricultural statistics published during 1931–33 is included. The payment of an annual subscription of 10*s*. (excluding postage) secures both numbers of the supplement each year, and also confers the right to attend the meetings as an associate member of the Section. Orders and subscriptions should be addressed to the assistant secretary, Royal Statistical Society, 9 Adelphi Terrace, London, W.C.2, and marked I.A.R.S.

Poland and Germany

It is not generally realised that Berlin was originally a Slav settlement. In vol. 18 of *Nauka Polska* (Warszawa: Imienia Mianowskiego) Dr. K. Piotrowicz, director of the Library of the Polish Academy

of Sciences, gives a well-documented account of the manuscripts, documents, prints and other Polish works produced in early times on present German territory. It is clear that in the Middle Ages Polish culture played an important rôle in those lands now comprising eastern Germany, for many of the Polish kings and noblemen were patrons of learning. Also many scientific and other works by Polish authors were printed in towns as far west as Strasbourg. In the same volume there is an introductory note on the scientific and cultural relations between Germany and Poland by Prof. Aleksander Brückner, of the University of Berlin.

Science in Poland

VOL. 19 of *Nauka Polska* (issued simultaneously with vol. 18) contains articles on science in ancient times; problems in writing biographies; current scientific work at Lwów; the position of science in Italy, Greece, Rumania and Lithuania; and a full account of recent activities in England of the British Science Guild, the Association of Scientific Workers and the Parliamentary Science Committee. The volume concludes with a comprehensive international bibliography (20 pages) of "works concerning the psychology and sociology of science" for the years 1928–31. From Prof. T. Mańkowski's report on scientific and cultural life in Lwów at the present time it is clear that, in the faculties for pure science and medicine, modern equipment has been installed and everything is being done to encourage research workers and to see that they are not hampered by lack of facilities. Since the establishment of the Polish Republic, Lwów has become an increasingly important scientific centre in south-east Poland. A polytechnic and medical school existed before the War, but all cultural life came to a standstill in 1914 and it was not until 1920 that circumstances were favourable for the re-establishment of a university in this city.

Antarctic Exploration

THE *Penola*, the vessel of Mr. J. Rymill's antarctic expedition, according to the *Times* of August 10, was commissioned at Southampton last week and carried out preliminary trials preparatory to sailing for London, where the stores and scientific instruments will be taken on board. The expedition's aeroplane, a three-seater De Havilland Fox Moth, about sixty tons of stores and some sixty Greenland dogs have already been sent out to the Falkland Islands by cargo-steamer. The *Penola* is due to leave London on September 2 for the Falkland Islands, calling on the way at Monte Video. The staff of the expedition will themselves constitute the crew under command of Lieut. R. E. D. Ryder, R.N. The *Penola* is a three-masted topsail schooner with two 50 H.P. Diesel engines. Most of the members of the expedition have already had arctic or antarctic experience. While the work will be primarily exploratory, attention will be paid to various scientific problems including plankton, the occurrence of 'heavy water', the sociology of penguins and meteorological work. It is hoped to trace the southern extensions of the Antarctic Andes which are known as the Graham Land islands. Although the expedition hopes to be away for more than two years, the total cost is not expected to exceed £15,000, which is considerably lower than that of any other previous expedition. There is also news of Admiral Byrd's antarctic expedition; Admiral Byrd himself has been living alone at an observation hut some 120 miles south of his base camp in the Bay of Whales in order to secure continuous meteorological records. He had recently asked to be relieved owing to illness, and a rescue party succeeded in reaching him on August 13.

American Trans-Antarctic Flight

THE original plan of the Ellsworth Antarctic Expedition for a flight across Antarctica from the Ross Sea to the Weddell Sea and back to the base had to be abandoned last January owing to serious damage to the aeroplane on the pack-ice. Mr. Ellsworth now proposes new plans for the southern summer of 1934–35, and explains them at length in *Natural History* of July–August 1934. His ship, *Wyatt Earp*, will reach Deception Island about November 1. From there, Messrs. Ellsworth and Balchen propose to fly southward along the unknown western edge of the Weddell Sea to the ice-barrier at its head and then straight across Antarctica to the Bay of Whales on the Ross Sea, a total distance of 2,800 miles over virtually unexplored areas. The ship will go round to the Ross Sea to pick up the expedition, which will no doubt have the use of Byrd's base in the Bay of Whales. The plane has a maximum speed of 210 miles an hour, and it is proposed to fly at 150 miles an hour. Fully loaded, with pontoons in place of ski, its cruising radius is 3,200 miles. The use of pontoons, which materially increases the weight, is necessary because Deception Island does not offer a land surface sufficiently extensive for a 'take off' for this heavy machine.

American Indian Land-Tenure

A MOVEMENT has been initiated in the United States for the reform of the terms of land-tenure among the Indians. Under the law of 1887, lands were allotted to the Indians on individual tenure, a system of which they had had no experience under tribal institutions. No sooner had allotment been made than land dealers began to acquire holdings from the Indians, in many instances in exchange for a few bottles of whisky or other articles of little or no value. It is estimated that in less than fifty years the Indians have lost two thirds of their lands, and whole tribes have been reduced to pauperism. A conference has been summoned, it is announced by Science Service, Washington, to discuss this situation, as well as other problems affecting the Indians. It will be attended by representatives of the Indian Rights Association, the National Association on Indian Affairs and many other bodies interested in the welfare of the Indian. The Commissioner of Indian Affairs, Mr. John Collier, will also attend. Special attention will be given to drafting proposals

for the amendment of the land laws. Among the reforms it is intended to propose is the reintroduction of the system of tribal tenure. It is understood that this proposal has the approval of the Indian Office. Suggestions are also to be considered for the establishment of a system of credit for the Indians in order to enable them to equip and stock their farms, as they are not otherwise in a position to work any land which may be assigned to them. It is certainly desirable that something should be done to establish on an economic basis the half-detribalised Indians who at present are largely parasitic on the fringes of white communities. The passing of a revised land-law which would restore the Indian to the land without the power of alienation would probably prove a substantial advance in that direction.

Grading of Empire Hardwoods

A SMALL brochure has been prepared by the Imperial Institute Advisory Committee on Timbers entitled "Grading Rules and Standard Sizes for Empire Hardwoods" (Imperial Institute, South Kensington, Oct. 1933). The Sub-Committee, appointed by the Advisory Committee, decided that these inquiries should be confined to overseas Empire square-edged hardwoods. The grading rules and memorandum on sizes recommended by it will be subject to amendment from time to time, as further experience is gained. The grading rules for Empire hardwoods (square-edged) intended for shipment to the United Kingdom are considered under: A. Hardwoods from Countries other than Canada and New Zealand, I Standard Grades. II Wormy Grades. III Grades for shorts, squares, strips, quarter-sawn stock. B. Canadian Hardwoods. C. New Zealand Hardwoods; and appendixes. This piece of work was overdue and should prove of great value to all concerned in this matter of hardwood imports. The danger of laying down hard and fast grading rules for any particular item of imports may result, however, in great waste at the source of origin—a waste which has to be seen on the spot to be fully realised. For example, under "Squares" it is stated, "*First Quality or Prime Squares* must be free from all defects, except that, when squares are sold specifically for turning, slight defects on one or more corners which will turn off will be admitted". In the case of mahogany, to obtain the flawless squares, sections of logs of 2–4 ft. will be cut off and left to waste in the forest owing to some small flaw which the manager on the spot will not risk sending home since he will be censured by the management. The latter will not have this type of material sent home since they know it will be objected to by the buyers. Is it necessary to waste annually thousands of cubic feet of so magnificent a timber as mahogany because the specification of import laid down by the purchaser approaches an ideal?

Wireless Communication at Mount Everest

A paper entitled "Wireless Communications with the Mount Everest Expedition, 1933", read before the Royal Society of Arts by Mr. D. S. Richards, has now been published (*J. Roy. Soc. Arts*, May 11). The plans provided for the installation of a main fixed station at Darjeeling, the starting point of the expedition, and two mobile transmitting and receiving stations to be erected at the Base Camp and Camp III at altitudes of 16,800 ft. and 21,000 ft. respectively. The distance from Darjeeling to the Base Camp was about 111 miles, with a further 10 miles to Camp III, from which a telephone line was to be laid to Camp IV about 1½ miles distant and at a height of 22,800 ft. Communication was carried out by telephony when possible, with recourse to Morse telegraphy when conditions were less favourable. Wave-lengths in the region 40–60 metres were found to be the most successful, and the best time for communication was in the early morning when fading and interference from atmospherics were reduced to a minimum. On the whole, the wireless equipment worked satisfactorily, and the service provided was of great value to the climbers. Weather reports were delivered to Camp IV within an hour or two of their being originated in Calcutta. Radiotelephony proved a great success on occasions, notably when H.E. the Governor of Bengal spoke to some members of the expedition from Government House, Darjeeling, and also when the Civil Surgeon in Darjeeling was consulted about some medical cases. Dr. Greene also carried out a diagnosis by radio between Base Camp and Camp III when there was no doctor in the latter Camp. Not least among the advantages provided was that of the reception at Base Camp of broadcasting programmes and news bulletins.

Road Construction in New Germany

IF we leave the United States out of account, it is at first sight curious that countries overburdened with financial liabilities take the leading part in promoting road construction. During a period of great prosperity, the United States built a gigantic network of highways. Yet when unemployment increased, further energetic steps were taken to increase the road work being done. During the former period, maximum use was made of machinery, but now the tendency is to employ manual labour as much as possible. In *Roads and Road Construction* of April, there is an interesting paper by Prof. K. Krüger, of the Technical High School, Charlottenburg, describing the latest German *autobahn* (super-highway) scheme. At the motor exhibition in March at Berlin, Herr Hitler urged the encouragement of motor-vehicle traffic as this would provide work for hundreds of thousands of men. The *autobahn* project has been fostered, and the construction of powerful high-speed vehicles—almost semi-aircraft—is being encouraged. It is intended that the high-speed traffic should be collected on the *autobahn*. The ordinary roads not built for the present dense heavy and rapid traffic would be saved from the necessity of constant repairs and efforts would be made to improve them. The super highway will enable the motorist to speed up to at least 90 miles per hour. A lorry driver will be able to travel between two distant cities twice a week instead of making only one return trip. The deterioration of

the lorry and the general transport costs will be considerably reduced. The new roadways will open up many new picturesque places which will attract foreign visitors. According to the law of June 27, 1933, the German State railways have been authorised to create a subsidiary company to build and manage an efficient network of super highways as a monopoly.

Ceralumin

MESSRS. J. STONE AND Co., LTD., of Deptford, have introduced a new light alloy to which they have given the name of "Ceralumin C". This alloy contains copper 2·5, nickel 1·5, magnesium 0·8, iron 1·2, silicon 1·2 and cerium 0·15 per cent. It thus belongs to a well-known class of light alloys, but contains cerium in addition to the more usual elements. It is claimed that cerium refines the microstructure, and also suppresses the formation of the brittle iron–aluminium constituent. The alloy is used in the heat-treated condition, being heated to 515°–535° C. for four to six hours in order to bring the constituents into solid solution, and then quenched. Ageing is effected in 16 hours at 175°, after which the alloy is again quenched. Chill castings after heat treatment have a tensile strength of 23–27 tons/in.^{2}, a proof stress of 21–24 tons/in.^{2}, an elongation of 1 per cent, and a Brinell hardness of 130–140. A fatigue range at 20 million reversals of $\pm 8{\cdot}25$ tons/in.^{2} has been obtained, which is high for alloys of this class. When the ageing at 175° is replaced by ageing at room temperature for five days, the tensile strength is lowered, but an elongation of 4–6 per cent has been obtained. This modified alloy is called "Ceralumin D". Sand castings give rather lower figures. The new alloy is claimed to give smooth castings, and to be suitable for many kinds of aeronautical and automobile purposes.

A 'Perfect' Musical Scale

IN Chap. viii of his forthcoming work on "Some Questions of Musical Theory" ("From Seven to Seventeen". Pp. 137–166. Cambridge: W. Heffer and Sons, Ltd., 1934. 2*s*. 6*d*. net), Dr. W. Perrett divides the octave into 171 intervals which he calls 'hepts'. One sixth of a hept is the least difference of pitch which can be detected by a trained ear and Dr. Perrett shows that if the eleventh, thirteenth and nineteenth harmonics can be dispensed with, 50 of the intervals best known in music can be represented by integral numbers of hepts with errors of less than one seventh of a hept. Thus the fifth is 100, the fourth 71, the major third 55, the minor third 45. With an instrument constructed on these lines, modulation into any key would be possible, but if it were played by hand four players would be necessary. As an instrument with Bosanquet's 84 keys per octave was constructed at a moderate price half a century ago, the author considers that one with 171 is quite within the bounds of possibility at the present time.

Land Utilisation Survey

THE third annual report of this survey of Great Britain shows a growing rate of progress towards the completion of the work. With a total of 15,000 finished six-inch sheets, three-quarters of the field work has now been accomplished. Thirty-six counties are completed and twenty-five more are nearly complete. Parts of Norfolk, West Suffolk, the West Riding, Westmoreland, Cornwall, Carmarthen and Somerset still call for more workers. In southern Scotland there are large areas still to be done. A year ago two sheets, reduced to a one-inch scale from the six-inch sheets, were published by the Ordnance Survey. Eight sheets in all have now been published and four more are in the press. Work is proceeding on the reduction and preparation for press of twenty-nine further sheets. It is proposed to publish a series of explanatory memoirs on certain of the sheets and several of these are now in preparation. The report summarises the extent of work done in each county and contains a map of Great Britain showing completed areas.

The Imperial Institute

THE annual report of the Imperial Institute contains the last report of the retiring director of the Institute, Lieut.-Gen. Sir William Furse, to the Board of Governors. Sir William there affirms his belief that the threefold activities of the Institute—(1) intelligence, (2) investigations and (3) education—are of immense importance and essential to the economic development of the Empire. He adds that the Imperial Institute is still not sufficiently known and is left overmuch to carry on as best it can. It has never been financed adequately, but from time to time an outside Committee is appointed to investigate the Institute, usually when bankruptcy appears to be impending. Its own resources, from its original endowment and from the letting of rooms, amount to less than £10,000 per annum: Sir William estimates that it requires an income four to five times this figure. He points out that the Institute has only been kept alive for the past ten years by the munificence of private donors and adds: "In no spirit of ingratitude to these gentlemen, I venture to suggest that this method of carrying on our essential Imperial service is unworthy of our great Empire."

The Cooling of Boulder Dam

THE Boulder Dam forms a huge concrete plug between the walls of the Black Canyon on the Colorado river. According to Science Service of Washington, D.C., it weighs six million five hundred thousand tons. As this concrete sets, the slow chemical reaction that takes place gives off heat. Researches by the U.S. Bureau of Reclamation have shown that in the Boulder Dam sufficient heat would be generated to melt a cube of ice as high as a 24-story building. If no means were adopted to keep cool this great block much damage might be done, as during the protracted cooling and shrinking period there would be a serious risk of dangerous cracks occurring. To obviate this risk, as each section of the concrete is poured it is riddled with coils of pipe. About 560 miles of tubing will be used, and this will be kept in place permanently as the cement hardens.

Administrative Measures in Puerperal Fever

INVESTIGATIONS carried out for the Departmental Committee on Maternal Mortality have shown the importance of strains of the micro-organism known as the hæmolytic streptococcus, and of carriers of this organism, in the causation of puerperal fever. The Ministry of Health, in a circular recently issued to Medical Officers of Health, therefore recommends on the occurrence of fever in a lying-in woman the isolation and separate nursing of the patient, and investigations to determine the nature of the infecting organism and possible sources of infection. The last-named include bacteriological investigation of the patient and of those who may have been in contact with her during labour and for 48 hours afterwards. As contact with hands and instruments is the most likely mode of infection of the genital tract, attention should be directed to infections or abrasions of the skin of anyone who has had contact with the patient.

Swedish Meteorology

AMONG recent publications of the Swedish Meteorological and Hydrographical Office are the detailed observations from the observatory at Riksgränsen on Vässijaure in Swedish Lapland for the year 1931 (*Årsbok*, 13, 1931). Full records are given for every hour on each day of the year, with additional notes on the freezing of the lake, aurora borealis and other matters. Another publication (*Årsbok*, 15, 1933) records the rainfall of Sweden. Monthly figures are given for each station with summaries for various districts and comparisons with the mean average figures. There are also rainfall maps for each month and for the year. It is noticeable that the year under review showed nearly everywhere in Sweden a considerable deficiency compared with the normal rainfall. A third publication treats of the weather of 1933 (*Årsbok*, 15, 1933) in a series of monthly surveys with comparisons with the means.

Plant Pathology at the Seale-Hayne Agricultural College

THE tenth annual report of the Department of Plant Pathology of the Seale-Hayne Agricultural College, Newton Abbot, Devon, contains several interesting articles by the entomologist (Mr. L. N. Staniland) and the mycologist (Mr. A. Beaumont). The general activities of the Department are reviewed, and reveal a very efficient and progressive organisation. Short articles appear on "The Spread of Potato Eelworm in Consignments of Seed Potatoes", "The Alternative Host Plants of the Violet Aphis", "Violet Eelworm" and "Notes on Hot Water Treatment of Strawberry Runners" together with several paragraphs describing its effects on various pests. A useful article on "Narcissus Disease and Pest Control Calendar" guides the grower in the general treatment of his bulbs (a study which is somewhat neglected by many home gardeners) in addition to discussing the control of pests and diseases. More general notes on insect and fungus maladies which have occurred during the year, and lists of those found in Devon and Cornwall, are also given.

'Insulin-Boots'

WE have received from Messrs. Boots Pure Drug Co., Ltd., Nottingham, an illustrated booklet describing the preparation and uses of Insulin-Boots. The insulin is extracted from frozen pancreas glands by mincing into an alcoholic solvent; further treatment of the solution is necessary to remove the bulk of the inactive protein. The resulting clear solution is concentrated at low temperature by vacuum distillation. After removal of fat the insulin is precipitated by addition of salt and further purified by fractional precipitation in the iso-electric range and from various solvents. The booklet describes the tests to which each batch is submitted, the properties of insulin and its use in diabetes and in non-diabetic conditions. A useful section is a detailed account of the technique of subcutaneous injection. Insulin-Boots is issued in three strengths, 20, 40 and 80 units per c.c.

Announcements

THE RIGHT HON. THE EARL OF MALMESBURY has consented to become president of the next Health Congress of the Royal Sanitary Institute, which is to be held at Bournemouth on July 15–20, 1935.

THE B.B.C. announces that the public experiment with the 24-hour system of timing, which began in April, will end on August 18. It is stated that the system has been effectively introduced to the public, but there has been no evidence of either widespread support or opposition for it.

THE Autumn Meeting of the Iron and Steel Institute will be held in Belgium and Luxemburg on September 10–14. The programme includes visits to the principal iron and steel manufacturing and engineering works of the two countries. Advance copies of papers to be read can be obtained from the secretary of the Institute.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Junior technical assistants (temporary) under the Director of Ordnance Factories—Under-Secretary of State (C.5), War Office, London, S.W.1 (Aug. 22). A county dairy instructor (male) to the Wilts County Council—Clerk of the Council, County Offices, Trowbridge, marked "County Dairy Instructor" (Aug. 27). An engineer sub-lieutenant in the Royal Indian Marine—Secretary, Military Department, India Office, Whitehall, S.W.1, marked "Royal Indian Marine Recruitment" (Aug. 31). An adviser in agricultural zoology at University College, Cardiff—The Registrar (Sept. 1). A head of the Engineering Department, St. Helens Municipal Technical School—The Secretary for Education, Education Office, St. Helens. A public analyst for the Boroughs of Kensington and Hammersmith—Town Clerk, Kensington, W.8. (Sept. 7). University readerships at the British Post-Graduate Medical School in medicine, surgery, obstetrics and gynæcology, pathological chemistry and bacteriology—Academic Registrar, University of London, S.W.7 (Sept. 17).

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The *J*-type and the *S*-type among Mathematicians

MATHEMATICIANS in England and America have been recently intrigued by reports of a lecture delivered by Prof. L. Bieberbach, of the University of Berlin, to the Verein zur Förderung des mathematisch-naturwissenschaftlichen Unterrichts. They have, however, found difficulty in judging the lecture fairly from secondhand reports. It is now possible to form a more reasoned estimate, Prof. Bieberbach having published a considerable extract, under the title "Persönlichkeitsstruktur und mathematisches Schaffen", in the issue of *Forschungen und Fortschritte* of June 20.

Prof. Bieberbach begins by explaining that his exposition will make clear by examples the influence of nationality, blood and race upon the creative style. For a National Socialist, the importance of this influence requires no proof. Rather is it intuitive that all our actions and thoughts are rooted in blood and race and receive their character from them. Every mathematician can recognise such influences in different mathematical styles. Blood and race determine our choice of problems, and so influence even the assured content of science (den Bestand der Wissenschaften an gesicherten Ergebnissen); but naturally do not go so far as to affect the value of π or the validity of Pythagoras' theorem in Euclidean geometry. . . .

Our nature becomes conscious of itself in the malaise (in dem Unbehagen) produced by alien ways. There is an example in the manly rejection (mannhafte Ablehnung) of a great mathematician, Edmund Landau, by the students of Göttingen. The un-German style of this man in teaching and research proved intolerable to German sensibilities. A people which has understood how alien lust for dominance has gnawed into its vitals . . . must reject teachers of an alien type. . . .

Prof. Bieberbach proceeds to distinguish between the '*J*-type' and the '*S*-type' among mathematicians. Broadly, the *J*-type are Germans, the *S*-type Frenchmen and Jews. The differences of type appear quite clearly in the varying treatments by different mathematicians of the theory of imaginary numbers. For example, in Gauss (an outstanding instance of the *J*-type) one finds above all insistence on the 'anschauliche Bedeutung von $\sqrt{-1}$'. . . . On the other hand, there are expositions of the theory by mathematicians of the *S*-type (for example, Cauchy) which produce a malaise (die Unbehagen verursachen) in one belonging to the *J*-type. . . . Technical virtuosity and juggling with conceptions are signs betraying the *S*-type, hostile to life and inorganic (dem Lebensfeindlichen unorganischen *S*-typus). . . .

Typical of the *J*-type are the 'nordisch-falische' Gauss, the 'nordisch-dinarische' Klein, and the 'ostbaltisch-nordische' Hilbert. . . . One of the crowning achievements of the *J*-type is Hilbert's work on axiomatics, and it is particularly regrettable that abstract Jewish thinkers of the *S*-type should have succeeded in distorting it into an intellectual variety performance (intellektuelles Varieté). . . .

But perhaps I have quoted enough; and I feel disposed to add one comment only. It is not reasonable to criticise too closely the utterances, even of men of science, in times of intense political or national excitement. There are many of us, many Englishmen and many Germans, who said things during the War which we scarcely meant and are sorry to remember now. Anxiety for one's own position, dread of falling behind the rising torrent of folly, determination at all costs not to be outdone, may be natural if not particularly heroic excuses. Prof. Bieberbach's reputation excludes such explanations of his utterances; and I find myself driven to the more uncharitable conclusion that he really believes them true.

G. H. HARDY.

New College, Oxford.
July 20.

Crystal Structure of the Low Temperature Modification of Ammonium Bromide

IN continuation of the accurate dilatometric investigation of ammonium chloride carried out by Prof. A. Smits and Miss C. H. MacGillavry[1] in the neighbourhood of the well-known transition point at $-30°$, ammonium bromide has been studied by them and by the present writer in the neighbourhood of the analogous transition point at $-39°$. In connexion with these experiments, which have not yet been finished, these ammonium salts, especially ammonium bromide, have been investigated with X-rays by me. By arrangement with Prof. Smits, the results of these latter experiments are described here.

In the case of the corresponding chloride, F. Simon and Miss Cl. von Simson[2] failed to detect a difference in the X-ray diagrams taken below and above the analogous transition point, which I can wholly confirm. I have now found, however, that Debye-Scherrer diagrams of pure ammonium bromide with copper $K\alpha$-rays taken at $-100°$ did show besides the ordinary reflections of NH_4Br a number of faint and very faint lines not present in diagrams of the same preparation at room temperature. As volatile impurities such as water and carbon dioxide were excluded, these extra lines reveal the occurrence of a superlattice in the crystal structure of the low temperature modification, afterwards to be designated as γ-NH_4Br.

From the observed reflections, two possible elementary cells could be deduced. First, a body-centred cubic cell with an edge $a = 2a'$ (a' representing the edge of the elementary cube of the ordinary $CsCl_2$-structure of the β-modification, stable from $-39°$ to $138°$) and containing eight molecules; secondly, a tetragonal elementary cell with $a = a'\sqrt{2}$ and $c = a'$, containing two molecules. From a discussion of the possible atomic arrangements in both cases in connexion with the observed and calculated intensities, the first alternative could be excluded. In this way we arrive at the conclusion, that at low temperatures NH_4Br has a tetragonal lattice with the dimensions at $-100°$: $a = 6 \cdot 007 \pm 0 \cdot 006$ A.; $c = 4 \cdot 035 \pm 0 \cdot 004$ A.; $c/a = 1/\sqrt{2} = 0 \cdot 707$. This conclusion is in remarkable accordance with

the observation of Hettich[3], who found the γ-modification to show double refraction.

An exhaustive examination of the tetragonal space-groups reveals that only the space-groups D_{4h}^7, D_4^2 and V_d^3 are possible. The bromine and nitrogen atoms occupy in all three groups the same places;

$$\text{Br}: 0\ \tfrac{1}{2}\ u,\ \tfrac{1}{2}\ 0\ \bar{u}\ ;\ \text{with}\ u \cong 0\ (\text{or} \cong \tfrac{1}{2}).$$
$$\text{N}\ : 0\ 0\ \tfrac{1}{2},\ \tfrac{1}{2}\ \tfrac{1}{2}\ \tfrac{1}{2}\ ;\ (\text{or}\ 0\ 0\ 0\ ,\ \tfrac{1}{2}\ \tfrac{1}{2}\ 0).$$

With a value $u = 0{\cdot}030 \pm 0{\cdot}005$ for the only parameter, the intensities can be calculated in excellent agreement with those observed. As Hettich failed to observe piezoelectricity of the γ-modification of NH_4Br, it may be concluded that D_{4h}^7 will be the correct space-group. Assuming that in the γ-modification the ammonium radical only oscillates about fixed positions, the protons will be arranged in tetrahedrons round the nitrogen atoms. They will then occupy an 8-fold position : 8(i) in the designation of Wyckoff with two parameters.

Ammonium iodide shows the same behaviour as the bromide but to a minor degree. The parameter value u is here $0{\cdot}01 \pm 0{\cdot}005$; only some very faint lines were detected corresponding with the strongest extra-lines of ammonium bromide.

J. A. A. KETELAAR.

Laboratory for General and
Inorganic Chemistry,
University of Amsterdam.
July 8.

[1] *Z. phys. Chem.*, A, **166**, 97 ; 1933.
[2] *Naturw.*, **14**, 880 ; 1926.
[3] *Z. phys. Chem.*, A, **168**, 353 ; 1934.

Refractive Index of Gaseous "Heavy Water"

IT may be of interest to record that preliminary measurements of the refractive index of a specimen of gaseous heavy water give a value of $\mu = 1{\cdot}000256$ for $\lambda = 5462{\cdot}23$. The specimen, which was supplied by I.C.I., had a relative density of $1{\cdot}0324$ at $23{\cdot}3°$ C., and a concentration estimated at 30 per cent D_2O on the assumption that the density of pure D_2O is $1{\cdot}1079$[1]. The standard density of the vapour was taken as that of hydrogen at 0° and 76 cm., multiplied, as to 70 per cent, by 9 and as to 30 per cent by 10 ; thus :

$$0{\cdot}08995\left(\frac{70 \times 9}{100} + \frac{30 \times 10}{100}\right) = 0{\cdot}83653 \text{ gm. per litre.}$$

The refractive index of ordinary gaseous water was found in 1914 to be $1{\cdot}0002527$[2] and recent unpublished determinations have given $1{\cdot}000255$. This latter value is so near that of heavy water that it is doubtful whether there is, in reality, any difference between the two. I hope to complete measurements of the refraction and dispersion and to publish the results before November.

If the density of pure liquid D_2O is $1{\cdot}1079$, while the molecular weight is 20, against 18 in the case of water, the molecular volume of D_2O has increased, relative to that of water, in the proportion of $1{\cdot}1079$ to $1{\cdot}111$ or $\frac{1}{2}$ per cent ; and, on the assumption that the abnormality of the D atom has no effect, or a very small effect, on the refractive index, we should expect a slightly lowered index for D_2O, but not so great a difference as that actually found by Taylor and Selwood, who give the difference of indices of pure D_2O as $-0{\cdot}00462$ at 20° C.

If it should prove correct that the index of gaseous D_2O is slightly higher than that of H_2O the discrepancy becomes greater.

CLIVE CUTHBERTSON.

July 26.

[1] H. Taylor and P. W. Selwood, *J. Amer. Chem. Soc.*, 998 ; 1934.
[2] C. and M. Cuthbertson, *Phil. Trans.*, 213, 1.

J. F. Campbell, 1822–85, and his Refracting Quadrant

LAST year I purchased at auction a well-made piece of optical apparatus which intrigued me because I could not divine its purpose. It looked like a sphere of glass with circles etched upon it, set in a block of wood. After cleaning, some writing and the initials 'J. F. C.' appeared on the box which, to make a long story short, turn out to be those of J. F. Campbell. But although his name as applied to the Campbell-Stokes Sunshine Recorder is a household word, none of the physicists or meteorologists to whom I applied for information knew anything about the man. Nor have I been able to find that any obituary notice of him appeared in NATURE or in the usual journals.

Campbell of Islay, as he liked to call himself, was born on December 29, 1822, and died at Cannes on February 17, 1885. He was educated at Eton and Edinburgh. His published works show his genius to have been of no ordinary kind. The best-known of these is perhaps his "Frost and Fire", in two volumes, with a picture of Hecla and Strokr on the title-page, but no author's name either there or at the end of the preface, dated London, April 1865. Only in a postscript does he add the modest note : "My name will not help this comrade in his journey through the world ; but my friends the publishers, to whom I am indebted for many favours, request me to sign this letter of introduction for their nursling 'FROST AND FIRE'. I have then to ask indulgence for my rude work, and for myself. J. F. Campbell" ; then follows a "Table of Contents" which is in tabular form in 8 columns. In the text symbols are used :— $\wedge$ for cone, L = river mark, Δ = ice mark, S = river curves, $\smile\wedge$ = ice mark and weathering, , = current. Large portions of his diary of 1850 are intercalated. So imbued was Campbell with the importance of making Nature print its own records that even the blue cloth binding of these volumes is embellished with an impression of glacial scratchings taken from a glaciated slate-rock surface—a veritable geological Nature-print.

In August 1879, when residing at Niddry Lodge, Kensington, Campbell prepared for the press a small work on "Time Scales : horizontal and vertical" which he had contrived for "numerical picture-writing and reading". He was also busy elaborating the details of the Sunshine Recorder.

"In order to work with radiation and new materials, apparatus had to be chosen or invented and made. The Instruments chiefly used since 1853, have been transparent spheres. In 1853, the only solid spherical lenses that could be found, were bottle stoppers and glass marbles. They were not clear, and they were ill-shaped and small. They served to show what was wanted, and they were used to learn something about the refraction of heat. Cast glass spheres, and spheres

worked hot with pincers by hand and eye, were got and used.

"In 1860 Messrs. Chance of Birmingham made a glass sphere for the writer, cast, ground and polished. It is at Greenwich Observatory. In 1880 Messrs. Chance made a second lens for the writer, which now is at the same station, having done good work. At last, in 1881 Monsieur Feil of Paris made a good glass sphere of homogeneous optical glass, carefully worked. It is the thing wanted and vainly sought during 29 years; and it might be still better."

"Thermography", from which these notes are taken, appeared in 1883, and has also supplied a clue to my box-sphere. It was Campbell's Refracting Quadrant invented in 1853 and made in 1864 as an instrument for drawing to scale in true perspective, and for measuring angles when travelling. It is not a sphere, but a lens with a hemispherical upper surface of radius 2 inches, and a hemispherical lower surface at 3 inches distance. It was intended to be set in gimbals for taking the sun's zenith distance at sea. With a suitable reflector the direction of movement of clouds overhead is well seen, and their rate of angular velocity can be measured on a scale. The description ends: "This invention has not been published so one instrument only exists" ("Thermography", p. 140); and this has now been rescued from oblivion.

Campbell's name was well known to scholars of Gaelic literature, for he collected a number of folk tales in the Highlands and Isles between January 1856 and 1861, some of which were published in his Popular Tales of the West Highlands 1860–62, of which a new edition in four volumes appeared in 1890–93. Legends about the Dragon attracted him. So early as 1862 he had taken incidents from three versions and had compared them with other stories which he had collected on travels to Japan, China and Ceylon. In the East he made sketches of dragons, and on his return, lectured on them. "I take the story," he wrote, "from the Gaelic and tell it in my own words, generally where the scribe's language is prosy. But when passages occur which seem worth preservation—bits of recitation and quaint phrases—I have translated carefully. This is work honestly done while my head was full of the subject." Some of his manuscripts are preserved in the Advocates Library in Edinburgh.

R. T. GUNTHER.

Sensitivity of Dividing and Non-Dividing Cells to Radiation

DR. J. C. MOTTRAM has recently[1] described experiments in which he irradiated the root tip of broad beans and claimed to have confirmed the conclusion, arrived at by him in 1913, namely, that the dividing cell is more sensitive to radiation than the non-dividing cell.

This hypothesis was, in fact, advanced as early as 1906, to account for the fact that the fastest proliferating tissues are the most radio-sensitive, but, as pointed out by me elsewhere[2], it is not the only possible interpretation of this now very well-known principle. If the sensitive state was pre-mitotic we would still find the most rapidly proliferating tissues to be most sensitive to radiation. It is surprising to find that the above hypothesis, or assumption, unsupported by any further evidence, has been accepted by a certain school of radio-biologists as the only possible, and therefore the logical, interpretation of an experimental fact.

The object of this note is to show that, while Mottram's conclusion is consistent with his observations, it is not a logical interpretation, because of the possibility of one or more, other explanations.

In brief, Mottram found that: (*a*) during the middle of the day, fewer cells in the normal bean root are undergoing mitosis than early in the morning or late in the afternoon; (*b*) the effect of a given dose of radiation on the growth rate of the bean root, irradiated during the middle of the day, is less than that on a similar bean root irradiated early in the morning or late in the afternoon.

From these results, he concluded that the dividing cell must therefore be more radio-sensitive than the non-dividing or pre-mitotic cell. That this conclusion is clearly illogical, will appear from the following simple considerations: from the two above experimental facts, it follows that the greater biological effect is related in some way with the higher mitotic activity, but when due consideration is taken of the further fact that a high mitotic activity must necessarily be associated with a high pre-mitotic activity it is manifestly impossible from Mottram's experiments to determine which of the two states, the mitotic or the pre-mitotic, is more radio-sensitive. The situation, so far as Mottram's experiments are concerned, remains unresolved.

Some three years ago, working in the Strangeways Laboratory, Cambridge, I undertook a quantitative investigation[2] into the phenomena involved in the disappearance of the mitotic phases from irradiated tissue cultures, and during the course of the research obtained definite evidence of the fact that the pre-mitotic cell is more radio-sensitive than the mitotic cell. This result is the same as that obtained by Spear[3] and by Strangeways and Hopwood[4] and others, from the same laboratory.

WM. H. LOVE.

Department of Cancer Research,
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Sydney.

[1] Mottram, J. C., *Brit. J. Radiol.*, **6**, No. 70, 615; 1933.
[2] Love, W. H., *Archiv. Exper. Zellforsch.*, **11**, 463; 1931; and *Proc. Roy. Soc. N.S.W.*, **66**, 56; 1932.
[3] Spear, F. G., *Proc. Roy. Soc.*, B, **108**, 190; 1931. **110**, 224; 1932.
[4] Strangeways, T. S. P., and Hopwood, F. L., *Proc. Roy. Soc.*, B, **100**, 283; 1926.

IN my paper of 1913[1] the conclusion that the dividing cell is more sensitive to radiation than the non-dividing was arrived at from experiments on the ova of *Ascaris megalocephala*, in which the exact ratio of dividing to non-dividing cells was determined.

For example, when the percentage of the non-dividing cells was 100 under a certain condition of exposure, none were killed in three repeated experiments, whereas when the percentages of dividing cells were 100, 94, 97, then 56 per cent, 48 per cent, 50 per cent of the eggs were killed under the same conditions of exposure. In the first case there may have been some cells in the sensitive (according to Love and Spear) pre-mitotic stage, but they did not die. In the second case either none, six, or three cells could alone have been in the sensitive pre-mitotic stage, and these small numbers could not account for the striking difference in mortality obtained.

As regards my experiments with beans, they fell into line with the above; in this respect they conformed, though alone they could not be conclusive.

I agree with Love and Spear that they have shown that of the various stages through which the non-dividing cell passes between mitosis and mitosis, the pre-mitotic stage is the most sensitive. On the other hand, I know of no experiments of theirs where they have shown that the cell in the pre-mitotic stage (shortly before the disappearance of the nuclear membrane) is more sensitive to radiation than the cell during mitosis. It is known that a cell irradiated during mitosis continues to divide, and that daughter cells result; whereas a non-dividing cell may for a time be inhibited from division under the same conditions of radiation. But one cannot conclude that therefore one cell is more sensitive than the other, because the same measuring rod was not used in the two cases. In one case mitosis already begun was observed, and in the other the passage from the resting to the dividing state—two very different phenomena. In my own experiments the same measuring rod was used, either death of the cell in the case of *Ascaris* ova, or interference with growth of the cell in the case of bean roots.

Many radiologists would, I am sure, be grateful to Dr. Love or to Dr. Spear if they would describe in detail an experiment which proves that a cell about to divide is more sensitive to radiation than a dividing cell; and especially an experiment in which is clearly defined what was the measure of the sensitivity employed.

J. C. MOTTRAM.

Mount Vernon Hospital and
Radium Institute,
London.

[1] *Archives Middlesex Hospital*, 30.

Infectivity of Summer Sporangia of Potato Wart Disease in Incipient Infections on Varieties Immune in the Field

IT is known that a number of potato varieties which appear immune to wart disease (*Synchytrium endobioticum*) in the field develop incipient and transitory infections under the more intensive infection conditions in the laboratory. Investigation has shown that summer sporangia, and less often winter sporangia, are developed apparently normally until necrotic areas produced in the host interfere with the nutrition of the fungal parasite and cause it to be sloughed off, so that signs of infection disappear within a few weeks.

It is a question of some interest whether the sporangia developed under these conditions are viable and capable of infecting susceptible potato varieties. A number of attempts have been made to infect Arran Chief, a very susceptible variety, from incipient infections bearing summer sporangia. A few developed on Snowdrop, Bishop and Ben Cruachan, varieties which appear immune in the field, have given positive results producing normal warts in Arran Chief, showing that summer sporangia on these varieties produced normal zoospores capable of carrying infection. No infection was obtained from two other varieties tested, but such negative results may be due to the technical difficulty of preparing sufficient material with incipient infections bearing summer sporangia at the right stage for infection.

MARY D. GLYNNE.

Rothamsted Experimental Station,
Harpenden, Herts.

July 19.

Inheritance of Habits

AT this time of the day to try to prove qualitatively that some acquired habits are inherited is to linger in the atmosphere of an old-time controversy. I wish to press forward. I would like to see the problem transferred to another sphere of investigation. What is the kind of physical change that is heritable? Can it be correlated with an easily observable fact; so that knowing it we can predict whether a particular habit would be inherited or not?

What is habit? Consider the following: (1) When under the stress of a parasite some tissues of an organism react or are made to react in order to restore the original balance, they continue in their particular activity when the cause of the disturbance is overthrown. This is continuity of reaction when the stimulus is no longer present. (2) An expert driver of a motor-car reacts when he is in the car surrounded by his particular stimulus, that is, the environment of traffic, etc. When he is not in his environment his reaction is not called forth. This is continuity of reaction only in the presence of the stimulus. (3) Tissues composing the organism have their own habits. How far are these expressed in the behaviour of the organism as a whole? (4) The organism as a whole has recognisable habits. How far are these expressed in the behaviour of the various tissues composing the organism? (5) A stimulus may have been administered only once to which the organism has reacted. Then after many years the particular reaction would be called forth when the stimulus is again administered. This is continuity of reaction after a considerable lapse of time. (6) The creases of a garment are also a continuity of reaction. (7) The idealism that a body given an initial impetus in a certain direction will continue to move in that direction if there were no environment to absorb the energy, involves the idea of an acquired habit.

In these examples the continuity of reaction implies the idea of duration. What should be the duration to constitute a habit? A habit may be acquired and inherited, and after a few generations the habit may cease to appear in the offspring. A habit once inherited may not always remain in the heritable condition.

Some animals are more easily domesticated than others. Man has this property of educability in a pre-eminent degree. If this is an advantage to society it has also its disadvantages. Education is giving a direction to the available energy of the organism. It is always difficult to change the direction of an already strongly directed stream of energy. A fanatic is a person in whom the available energy is very strongly directed but the direction is not in his own hands. Others control and use him. In man, habit is an expression of experience, and no habit can be formed without surrounding it with emotional accretions.

If it is known what physical change has taken place, the control by other people of one's habits can be counteracted by having, for example, an injection.

All this may seem rather fanciful, but will, I believe, fall within the range of possible worlds.

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July 18.

Distribution of Chromosome Numbers in a Progeny of Triploid *Allium Schoenoprasum*

A CROSS between a tetraploid giant form of *Allium Schoenoprasum*, L. ($2n = 32$) and common diploid chive ($2n = 16$) gave a triploid F_1 ($2n = 24$). These F_1 plants were all completely self-sterile; but in free flowering a rather large number of seeds was obtained which gave rise to an F_2 generation of about 700 plants. These were derived from crosses within the triploid material; some of them may possibly have been the result of back-crossings with diploid types of chive flowering in the vicinity.

In this F_2 generation there occurred among the 620 plants examined all chromosome numbers between 16 and 34 except the number 20. In addition, there were 3 plants having the chromosome numbers of 38, 39 and 45 respectively. The frequency of the different chromosome numbers is interesting. The average of the entire F_2 generation is as high as $2n = 29$. The numerically highest class represented is $2n = 30$ with 185 individuals or 29·8 per cent of the entire progeny. The classes $2n = 29$–31 amounted to 65·8 per cent, while plants with a lower number of chromosomes than 24 did not amount to more than 6·7 per cent. The euploid chromosome numbers were formed in the following frequency: diploid in 7 cases, triploid in 21 cases and tetraploid in 38 cases. 9 trisomic plants occurred.

Examinations of the chromosome numbers in the first pollen division in triploids show that gametes are formed with different chromosome numbers in expected frequency, that is, all numbers between 8 and 16 occur, the number 12 being the commonest. The distribution of chromosome numbers observed in F_2 should thus be due to zygotic selection. Of the expected zygotes, those with a chromosome number of about $2n = 30$ are evidently the ones most easily formed and those of about $2n = 20$ the most difficult. The few plants observed to have a greater number of chromosomes than 32 originate from gametes with doubled chromosome numbers or (the numbers 33 and 34) possibly from non-disjunction gametes.

A detailed account of the morphology and cytology of the various forms of chive will be published shortly.

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July 17.

Effect of 2:6-Dichlorophenol-Indophenol on Tumour and Kidney Respiration

IT has recently been shown[1] that 2:6 dichlorophenol-indophenol, among other oxidising agents, inhibits reversibly glycolysis in muscle extract. It was of interest, therefore, to try the effect of this substance on tumour tissue. Though inhibition of glycolysis was not found, the effects on respiration were striking. The experiments were carried out with the Dixon-Keilin apparatus[2] and the concentration of dichlorophenol-indophenol in the bicarbonate-containing medium was $1 \cdot 3 \times 10^{-3}$ M.

It was found that in the absence of glucose in the medium, the respiration of cancer tissue (Philadelphia No. 1 Rat Sarcoma[3]) was practically completely inhibited, while with glucose there was no great effect —in one case a stimulation and in another a slight inhibition of respiration was found, and in each case a diminution in the respiratory quotient. With kidney cortical tissue, however, inhibition was practically complete whether glucose was present or not.

The accompanying table summarises the results.

Tumour Tissue	$-Q_{O_2}$	*R. Q.*	$Q_G^{O_2}$	$-Q_{O_2}$	*R. Q.*	$Q_G^{O_2}$
Glucose present						
Normal	7·7	0·82	12·0	11·6	0·92	19·5
With dye	12·2	0·66	13·4	9·1	0·73	10·8
Glucose absent						
Normal	11·2	0·74		11·4	0·81	
With dye	1·3	—		1·2	—	

Rabbit Kidney Cortex	$-Q_{O_2}$	*R. Q.*
Glucose present		
Normal	11·8	0·88
With dye	0·9	—
Glucose absent		
Normal	13·1	0·74
With dye	0	—

Kidney is a normal tissue which is comparable to tumour tissue in that its rate of respiration is not greatly affected by the presence or absence of glucose, and further experiments showed that addition of lactate was without effect on the inhibition. It would appear that the cancer tissue is able to produce from glucose a substance which counteracts the activity of the indophenol. It may be that this has some relation to the substance in cancer other than vitamin C which is capable of reducing dichlorophenol-indophenol[4,5]. The explanation of this phenomenon is being sought, and experiments with brain and other tissues will be made.

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June 21.

[1] Lipmann, *Biochem. Z.*, **265**, 133; 1933.
[2] *Biochem. J.*, **27**, 86; 1933.
[3] Waldschmidt-Leitz, McDonald, *et al.*, *Z. physiol. Chem.*, **219**, 115; 1933.
[4] Harris, NATURE, **132**, 27, July 1, 1933.
[5] Harris, NATURE, **132**, 605, Oct. 14, 1933.

Limits of the Energy Spectra of Positrons and Electrons from Artificial Radio-Elements

USING a method of coincidences in two Geiger-Müller counters, slightly modified in comparison with that previously described[1], we have investigated the energy spectrum of RaN, RaP and RaAl.

In the following table, only values for the end-points of the spectra are given.

Bombarded element	Radioactive element	Particle emitted	End point of the energy spectrum	Range of the incident α-particles
B	RaN	$\varepsilon+$	1450	5·5 cm.
Al	RaP	$\varepsilon+$	3700	6·1 cm.
Al	RaP	$\varepsilon+$	3700	5·2 cm.
Mg	RaAl	$\varepsilon-$	3050	6·1 cm.
	Th (C+C″)	$\varepsilon-$	2200	

To test and to calibrate the apparatus, the well-known spectrum of thorium (B + C + C″) was used. The end point of the thorium (B + C + C″) spectrum obtained is in good accord with data by other investigators. The spectrum of positrons from radio-phosphorus was measured for α-particles of ranges of 6·1 and 5·2 cm. The shape of the spectral curve and the end point value remain unaltered for both ranges. The value which was obtained for the

spectrum limit for positrons is higher than that reported by I. Curie and F. Joliot[2] but differs considerably (by 1,300 kv.) from that of L. Meitner[3].

We investigated also the dependence of the electron yield, and hence the yield of radio-aluminium atoms, on the range of the incident α-particles. In the case of magnesium, a mixture of radio-aluminium and radio-silicon appears, corresponding to the transformation of different magnesium isotopes; it seemed therefore reasonable to carry out this investigation separately for electrons and for positrons. The same apparatus was used and the number of electrons having energies exceeding 1,500 kv. counted, as a function of the thickness of mica sheets inserted between the source and the magnesium foil (thickness ca. 30–40 microns). The results obtained are shown below:

Number of electrons	Range of particles
1700	5·90 cm.
1100	5·60
620	5·40
340	5·00
270	4·55
120	3·80

In the range interval from 5 cm. to 3·8 cm., we observed a distinct step corresponding obviously to resonance penetration of α-particles in the magnesium nucleus.

Similar results were also obtained in the case of capture of α-particles by an aluminium nucleus.

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July 4.

[1] A. J. Alichanow, NATURE, 133, 581, April 14, 1934.
[2] I. Curie and F. Joliot, *J. Phys.*, 5, 153.
[3] L. Meitner, *Naturwissen.*, H. 22/24, 388; 1934.

The Second Spark Spectrum of Tellurium

THE arc and the spark spectra of tellurium, extending over the wide region between λ7000 and λ450 have been under investigation by me for the last two years under varying experimental conditions. Very useful data of the spectrum, especially in the vacuum region, have also been kindly made available to me by Dr. K. R. Rao and Prof. R. J. Lang. With the aid of these, the analysis of the very complicated second spark spectrum of tellurium has been elucidated. It is found that the fundamental intervals $5p^3P_0 - 5p^3P_1$, $5p^3P_1 - 5p^3P_2$, and $5p^3P_2 - 5pD^1_2$ are respectively 4,751, 3,410 and 9,198 cm.$^{-1}$. The terms ms^3P having a total separation of 7,952 cm. in the first number are gradually tending to their limiting value 9,227 cm.$^{-1}$ of Te IV[1]. The terms of the $6p$ state are generally in consonance with the corresponding terms of Se III[2]. The third ionisation potential of tellurium, as calculated from the above analysis, is about 29·5 volts. The complete analysis is being communicated to the Royal Society of London.

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June 28.

[1] K. R. Rao, *Proc. Roy. Soc.*, A, 133, 220; 1931.
[2] K. R. Rao and S. G. Krishnamurty, *Proc. Roy. Soc.*, A (in press).

Activities of Life and the Second Law of Thermodynamics

IN his last letter[1], Sir James Jeans writes: "It is a well-known, and indeed obvious, fact that entropy has different values according as it is measured with reference to atoms or molecules or other units." If by entropy he means the *absolute entropy* of a given *state* of a system, his remark, though true, has no bearing whatever on the point at issue. If, on the other hand, he means the *entropy change* in some definite *process*, such as the sorting out of trucks, then we suggest that he is unique amongst physicists in holding this opinion.

We have consistently maintained[2], and still maintain, that the entropy change associated with the sorting of trucks is of the order of magnitude (to within a few powers of ten) Nk, where k is Boltzmann's constant and N is the number of trucks sorted. Sir James Jeans, on the other hand, recently expressed the opinion[3] that N should denote the number of molecules in the trucks. He now apparently suggests that it is merely a question of convention. Though we have discussed the matter with several authorities, including one of the most eminent theoretical physicists of the world, we have failed to find anyone, other than Sir James Jeans, who disagrees with us. We are content, therefore, to leave the matter in dispute to the judgment of the readers of NATURE.

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E. A. GUGGENHEIM.
University of Reading.
April 21.

[1] NATURE, 133, 986, June 30, 1934.
[2] NATURE, 133, 530, April 7, 1934. 133, 869, June 9, 1934.
[3] NATURE, 133, 612, April 21, 1934.

Photodissociation of Molecules in the Schumann Ultra-Violet

LARGE energy quanta are needed to disrupt a bond in an organic molecule with simultaneous excitation of the radical set free to the emission of its characteristic spectrum. In some cases, however, this process may be produced in the Schumann ultra-violet.

While studying photochemical reactions induced in gases by light in this region of the spectrum, we were also able to observe the emission of the diatomic radicals OH and CN accompanying the photodissociation of more complex molecules.

The processes observed are:

$$h\nu + H_2O \rightarrow H + OH^*$$
$$h\nu + CH_3OH \rightarrow CH_3 + OH^*$$
$$h\nu + CH_3CN \rightarrow CH_3 + CN^*$$

where OH* and CN* are excited radicals emitting the bands at 3062A. and 3883A. respectively.

The work is now being extended to some other organic molecules.

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Research Items

Possession among the VaNdau. M. H. Ph. Junod describes in *Africa*, 7, 3, a case of VaNdau possession. The VaNdau established themselves among the Bathonga, well known from the description of them written by the late father of M. Junod, as a result of the reduction of the tribes of southern Mozambique in the course of last century. For a long time considered an inferior race and reduced to slavery, they, or rather the spirits of their deceased, have become a terror of the Bathonga, whom they seize in possession. The spirits of the dead VaNdau roam about seeking vengeance on those who have ill-treated them during life. They enter the living and torment them to such a degree that they are prepared to do anything that the spirit wills. Hence the Thonga have devoted themselves to the study of the means whereby these spirits may be propitiated. Many classes of the Ndau ancestral spirits are recognised, to each of which an appropriate chant or song is addressed. Many of these are full of obscene terms. This shows that the state of possession is assimilated to certain periods of life when the ordinary restraints are relaxed. There is no hesitation in abusing the spirit, as for example, in one chant, in which the daughter of a chief is addressed as a prostitute. The exorcist, an office which is not easy of attainment, is either 'called' or may be initiated officially. The period of initiation is six days, on the last of which the real ceremony takes place. It is an introduction to a spiritual knowledge and to a mystic state comparable to that of the mysteries of the beginning of the Christian era. The exorcist may be a man or a woman; and it is evident that they are well versed in taking advantage of the weaknesses of the people.

Bird Migration and Light Periodicity. Following upon the results of Rowan's experiments which suggest that light periodicity, through its influence upon activity, has a bearing upon the development of the gonads of birds, and so upon their migratory habits, L. J. Cole has tested light effects upon the mourning dove, *Zenaidura macroura carolinensis* (*Auk*, 50, 284; 1933). The normal reproductive cycles of mourning doves, or mourning doves with ring dove mates, kept in captivity in naturally lit rooms was found, over a period of years, to be similar to that of wild birds in the region where the captives were taken. Two pairs whose egg-laying dates were well established were placed in each of two separate artificially lit rooms, in one of which the diurnal light period was kept constant at 10½ hours, while in the other the period was increased by 45 minutes weekly up to a 'day' of 19½ hours. The result was that in the latter room one female mourning dove which for five previous seasons had not laid in spring until early in April, laid on February 4 and 5 and again on February 24 and 25, while the other, a ring dove mated with a mourning dove, laid fertile eggs on January 20 although no fertile egg had been laid by her since the preceding July, showing that the male mourning dove had also attained precocious reproductive activity. Of the females in the 'short day' room none had laid up to March 15. The numbers used in these experiments are small, but so far as they go they support the findings of Rowan and Bissonnette that reproductive activity is advanced by lengthening daily light.

Fossil Fishes from Wyoming. Mr. William L. Bryant, in his paper "The Fish Fauna of Beartooth Butte, Wyoming", Parts 2 and 3 (*Proc. Amer. Phil. Soc.*, **73**, No. 3, Feb. 1934), describes numerous remains of acanthaspid fishes consisting of detached head roofs and trunk plates. The discovery and exploration of the beartooth fish lens opened a new chapter in our knowledge of vertebrate evolution, revealing another locality where, in Lower Devonian times, lay a body of water teeming with fishes. The author is of the opinion that we still lack sufficient details of these rare members of the *Arthrodira* and know too little of their evolutionary history to warrant their removal from the class Pisces as is suggested by Heintz. No traces of the jaws or dentition have ever been found in the acanthaspids. Basing his opinions on the study of the teeth of the later arthrodires, Mr. Bryant assumes that the most primitive members were equipped with functional teeth similar in origin to those of the gnathostome, and presumes, until more evidence is forthcoming, that the *Arthrodira* including the *Acanthaspida* were true, if highly specialised, fishes, perhaps, in the remote past, having branched off from the Elasmobranch stem. In an appendix, Mr. Rudolph Ruedemann describes eurypterids from the same locality.

Gape-worm in Chickens. P. A. Clapham (*Proc. Roy. Soc. Lond.*, B, **115**; 1934) records the results of experiments on the transmission of gape-worm, *Syngamus trachea*, by earthworms. Examples of *Syngamus trachea*, obtained from the trachea of partridges, pheasants, chickens and rooks, were dissected and the eggs so liberated were cultivated in Petri-dishes in the laboratory until, in 10–14 days, they reached the infective stage. The earthworms, *Lumbricus terrestris* and *Eisenia fœtida*, employed in the investigation were obtained from soil which could not have been contaminated with larvæ of *Syngamus*. These earthworms were kept in sterilised soil in large Petri-dishes in the laboratory for a week to give them time to void the soil in the gut together with any free eggs or larvæ of helminths. They were then transferred to fresh soil and the eggs containing infective larvæ of *Syngamus* were added to the soil. At the end of 14 days or more the earthworms were washed and brushed with a camel-hair brush to remove soil particles and any adhering larvæ and were fed to chicks which had been reared in incubators. As an intermediate host of *Syngamus*, *Lumbricus terrestris* is much less important than *Eisenia fœtida*; the latter earthworm lives in soil containing decaying organic matter and hence can be found in large numbers on land over which stock is being raised intensively, for example, poultry runs, and hence this worm is a source of danger when young chickens are reared year after year on old land. All the chickens fed with infected *Eisenia* became infected with *Syngamus* and usually died with the trachea completely blocked. The number of *Syngamus* present varied from 6 to 51 pairs. About 50 per cent of the chickens fed with infected *Lumbricus* proved to have *Syngamus* in the trachea but the infestations were not fatal. Examinations of the infected *Eisenia* showed that the larvæ of *Syngamus* were third-stage larvæ and were encysted in the muscles of the body wall; they were not present in the intestine as previously reported by Walker.

It has been generally stated that infection with *Syngamus* could be established only in very young chickens but experiments recorded in this paper indicate that, using *Eisenia* as intermediate host, it is possible to transmit *Syngamus* to chickens about three months old, which are under-nourished.

Acceleration of Flower and Fruit Formation. Experiments carried on in the laboratories of Schering-Kahlbaum in Berlin by Prof. W. Schoeller and Dr. H. Goebel have furnished the result that progynon can accelerate the formation of flowers and fruits in hyacinths, tomatoes, lilies-of-the-valley, etc., when progynon is given in very small quantities to the roots either in watery solutions or in the earth ("Die Bedeutung des Follikelhormons für die Pflanze". Von Prof. W. Schoeller und Dr. H. Goebel, Berlin. Medizinische Abhandlungen. Jahrg. 5, Heft 2. Schering-Kahlbaum. A.G. Berlin.) The quantity for hyacinths was 200 units progynon a week. Although the progynon was not absolutely pure, it is thought improbable that this phenomenon may be caused by an impurity. In these experiments there is no question of an influence on the formation of flowers, but only of an acceleration of the development of primordia which were already present. It is well known that such an acceleration can be brought about by many other stimuli, such as ether, ethylene, hot water, cooling at a certain time, etc. It certainly is interesting if among these stimulants progynon also plays a rôle. It will be interesting to see whether these preliminary investigations are confirmed when they are carried out on a larger scale. It may be important to emphasise that this action of progynon is very different from the ***blütenbildende Stoffe*** of Sachs or root-producing substance of Went, Jr., where indeed new primordia are formed.

Formation of Urease by *Aspergillus*. An interesting study of the conditions necessary for urease formation by *Aspergillus niger* has been made by T. Miwa and S. Yoshii (*Sci. Reports Tokyo Bunrika Daigaku*, 1, 243; 1934). They find that the formation of this enzyme, as measured by its activity, depends chiefly upon the age of the culture and the acidity of the medium. Thus with increasing age, the apparent urease content rapidly decreases, while production is high in cultures below pH 4 and is at a maximum at pH 1·6–1·8. The addition of glucose or fat to peptone media also apparently favours production of the enzyme. The use of various sources of nitrogen, other than urea, has little effect upon the amount produced.

The Central Core of the Earth. Until about two years ago, no trace of distortional waves has been found on seismograms at great distances from the origin, and this absence has led to the conclusion that the earth contains a central core about 4,400 miles in diameter and composed of a material very different from that outside. Two earthquakes occurring in 1929 have recently led to a revision of this inference. The South Atlantic earthquake of June 27 was registered at Tokyo, 160·4° from the origin, and, according to Prof. A. Imamura (*Tokyo Imp. Acad. Proc.*, **8**, 354–357; 1932), the S' phase was clearly defined. Mr. L. Bastings has recently studied about fifty European records of the Buller (N.Z.) earthquake of June 17, and these have provided further evidence of the penetration of the central core by the shear or distortional waves. In a paper read before the Wellington Philosophical Society (reported in the *Dominion* of May 16, 1934), Mr. Bastings shows that the waves had travel-times that indicated a rigidity in the core agreeing remarkably with that of the extra-nuclear structure.

Some Properties of Positive Electrons. The *Physical Review* of June 1 contains an account in English of work by J. Thibaud on the positive electron. The positive electrons were produced by a lead foil wrapped round a γ-ray source, and were subjected to a new kind of focusing by an inhomogeneous magnetic field. The field is that lying round the periphery of the circular pole pieces of an electromagnet—it has a large radial gradient, and the paths of the particles are trochoidal. Particles from a small source are collected over nearly a hemisphere and guided round the pole-pieces. The focusing is not selective for velocity. The application of a suitable electric field shifts the spiralling beam of electrons. This electrostatic deflection, combined with measurements of the diameter of the trochoidal beam in a known magnetic field, allow a rough determination of e/m for the positive electrons which shows that e/m lies between half and double the value for negative electrons, and that the two values of e/m are probably identical within much closer limits. When thin absorbing screens are introduced, the scattering and slowing down of the positrons is similar to that of electrons, but with thicker screens the results are complicated by a process which appears to consist in the annihilation of the positive electrons with production of true quanta of energy about 0·5 m.e.v. The free path of a positron before this conversion takes place seems to correspond to a stratum of matter containing about 600 mgm. per sq. cm. Since similar figures are obtained for this quantity in air and in platinum the process must certainly be ascribed to encounters of the positrons with electrons. In addition to the production of positrons in lead, there seems to be a large 'natural' production of positrons from several radioactive elements.

Polarisation of Long Radio Waves. Although the propagation of long radio waves has been studied for some time, there are certain anomalous features, particularly in short-distance transmission. There are peculiar directional effects and a striking result of Hollingsworth shows that there is a pronounced rotation of the plane of polarisation of the downcoming waves at a receiving station during the sunrise and sunset periods. A. L. Green and G. Builder (*Proc. Roy. Soc.*, A, June) have applied the magneto-ionic ray theory to the propagation of these long waves. The calculations show that for propagation of waves along the earth's magnetic field the ordinary (electric vector vertical) and extraordinary rays are received with comparable intensities. When the propagation is across the magnetic field, the attenuation of the ordinary ray due to collisions of electrons in the upper ionosphere may be much greater than for the extraordinary ray, but the attenuations become nearly equal again if the frequency of collisions is very high. The rotation of the plane of polarisation observed by Hollingsworth is therefore to be explained as due to a transference of the reflection at daybreak to a region of the ionosphere about 50 km. above the earth's surface, where the collision frequency is high. The theory gives also a qualitative exploration of the directional anomalies in long-wave propagation.

Aberdeen Meeting of the British Association

IN previous articles reference was made to the suitability of Aberdeen as a centre for excursions and to the arrangements the Local General Committee have made whereby practical effect has been given to this feature of the forthcoming meeting of the British Association there. In the present article it is proposed to outline in brief some of the other local arrangements made for the convenience and enjoyment of visiting members.

The Committee has prepared for issue to members a Local Handbook, containing (1) information as to local arrangements, (2) descriptive articles on the general excursions, and (3) a guide to the City of Aberdeen and environs. These descriptive articles, written by such well-known Scottish authors as J. J. Bell, Evan M. Barron, H. B. Mackintosh and W. Douglas Simpson, should enhance the pleasure derived from participating in the general excursions. In addition, the Committee is issuing a map of the region, a plan of the City and a brochure on the works, etc., which may be visited.

Aberdeen is a city of many industrial interests, and although known as the "Granite City", its chief industry is not concerned with granite. The works to be visited have been chosen with care so as to ensure that a representative panorama of industrial Aberdeen is available for inspection. They include paper mills, a tweed mill, a granite yard, fish works, a fish meal factory, engineering works, a dairy plant, a paint and colour works and an envelope factory.

A feature of special interest has been provided through the courtesy of the Fishery Board for Scotland. The research vessel *Explorer* belonging to that Department will be berthed in Aberdeen Harbour during the week of the meeting and may be visited by members of the Association. Officials of the department will be aboard and will explain the nature of the work carried out. Weather permitting, a practical demonstration at sea will be given.

As one would expect, the municipal institutions of Aberdeen are operated in a manner which demonstrates at the same time both efficiency and economy in working. Visits to representative departments of municipal activity have been arranged.

Another item of interest is the display of practically all the exhibits shown at the recent Telford Centenary Exhibition in the Institution of Civil Engineers in London. This has been arranged through the courtesy of the owners of these exhibits and the good offices of Sir Alexander Gibb. While an adjunct of Section G (Engineering), the exhibition will be open to all visiting members and a curator will be in attendance to give information relative to the numerous exhibits.

The entertainments include a reception by the Lord Provost, Magistrates and Town Council on the Thursday evening, and in this connexion the civic authorities are arranging a welcome in accord with the traditional hospitality of the City.

On the afternoon of Tuesday, the University of Aberdeen is holding a garden party in the grounds of King's College in Old Aberdeen—a section of the City apart and still retaining in essence the main features of a medieval university town.

During the week commencing Monday, September 10, the students of the University are producing a play entitled "Town and Gown" in His Majesty's Theatre, and Monday and Tuesday performances will be 'British Association performances'. A brochure on the play is being prepared and will be circulated to visiting members; the play is a cavalcade—of great beauty in parts and uproarious fun in other parts. A "British Association" dance has also been arranged to take place in the Beach Ballroom on Tuesday evening. The Beach Ballroom is a beautiful building on the sea front with a dance floor reputed to be the best in Scotland. Various social and golf clubs in the City will be open to visiting members during the week of the meeting. These include the well-known Royal Aberdeen Golf Club at Balgownie—a seaside course among the best in Scotland.

A wide variety of sectional excursions has been arranged, but it is thought scarcely appropriate to refer to these in this article. Full information may be had in the Local Handbook and the Programme and Daily Time Table.

As to accommodation, practically all hotels in Aberdeen have already been booked up, particularly single bedrooms, but there is an ample supply of good class lodgings at reasonable rates. A large number of persons who do not usually let rooms have indicated their willingness to accommodate members of the Association for the week of the meeting.

Apart from these outward indications of the willingness of all interested in the City to ensure to members a happy and profitable visit of the Association to Aberdeen, it should be emphasised that there also awaits members a personal welcome of great cordiality and warmth. The cultural aspect of the Association's activities and the catholicity of interests represented by the thirteen sections make a special appeal to the Aberdonian. The welcome to the Association may be well summed up in the City's famous toast—"Happy to meet, sorry to part, happy to meet again."

The Waite Agricultural Research Institute

AN account of the history and development of the Waite Agricultural Research Institute from the year 1925, when its activities first started, up to 1932 has been issued by the University of Adelaide. Although the chief objective of the Institute is to conduct research on plant and soil problems, it also provides an advisory service to the Department of Agriculture in plant pathology and entomology and gives specialised courses of instruction for the agricultural degrees in the University of Adelaide.

The scope of the scientific work undertaken at the Institute covers a wide field. As might be expected, the limited rainfall and the development of a system of cereal and grassland management to suit such conditions, forms one of the major problems, and a study of the water requirements of plants under various manurial treatments and the differences exhibited by improved varieties of cereals and leguminous plants in this respect, has led both to increases in yield being obtained and also to the

extension of the area capable of supporting the crop. Pasture problems are being investigated both from the agricultural and the chemical point of view, special attention being paid to their mineral content and improvement by means of the introduction of superior species and strains.

Survey and classification of the various soil types in Australia forms a further branch of the work in the chemical section, and fertility problems, particularly in the irrigation settlements, are also being investigated. Entomological work has only been in progress since 1929, but already much valuable information has been obtained with regard to various pests of pasture, cereal and orchard crops. Diseases of agricultural crops inevitably form an important branch of the work of the Institute, and deficiency diseases due to a lack of some mineral element have also been successfully investigated. Breeding experiments with the view of securing varieties with improved resistance to fungus diseases form a natural corollary to the work of the plant pathology section.

Besides the land devoted to agricultural experiments, a certain area is reserved as a permanent park. Advantage has been taken of this to plant a portion as an arboretum, one section being used for indigenous, and another for introduced, species. The report includes a list, with abstracts, of the 141 papers published from the Institute during the years under review, reference to which will indicate the important results on widely different subjects which have already been obtained.

The British Pharmaceutical Codex

THE Codex Revision Committee of the Pharmaceutical Society of Great Britain is issuing in the form of small monographs the reports of its sub-committees* which have been considering different aspects of the Codex in view of its revision this year. The next issue will contain about 300 monographs on crude drugs of vegetable origin of which less than seventy are included in the British Pharmacopœia.

The report of the Pharmacognosy Sub-Committee gives a summary of the principal standards for crude vegetable drugs, which have been accepted provisionally for inclusion in the new edition of the Codex: the standards of purity are based on determinations of foreign matter, alkaloid content, ash, extractive, etc., carried out in a manner similar to the corresponding tests of purity for the drugs in the Pharmacopœia. The report does not deal with the larger part of the sub-committee's work which is concerned with the revision of the descriptions, characters, constituents and commercial varieties of crude vegetable drugs.

The report of the Action and Uses Sub-Committee supplies descriptive portions for about fifty drugs, mostly of animal origin, including antitoxins, toxins and gland products. Among the substances described are scarlet fever toxin and antitoxin, new tuberculin, antimeningococcal, antipneumococcal and antistreptococcal sera, gonococcal, pneumococcal and staphylococcal vaccines, rennet, extracts of parathyroid and suprarenal cortex, œstrin, desiccated stomach and vitamin A, B, C and D concentrates. Standards are suggested for the different preparations. In addition, the sub-committee has revised the "actions and uses" sections of about 1,000 monographs, although their recommendations are not included in this report.

The report of the Pharmacy Sub-Committee includes the principal new and revised formulæ, expressed in both metric and imperial systems, suggested for the formulary section of the Codex. In addition, according to the introduction to the report by the editor, Mr. C. E. Corfield, the sub-committee has worked out tests which it has recommended should be included to form B.P.C. standards for the different preparations. It has also recommended the inclusion of alcohol limits for the concentrated infusions, spirits and tinctures, as well as formulæ for a number of preparations from earlier pharmacopœias which are not included in the British Pharmacopœia 1932, but are still in more or less frequent demand. The reports are issued in the hope that useful comments on the suggested revisions will be received.

* The Pharmaceutical Society of Great Britain: Codex Revision Committee. Reports of Pharmacognosy Subcommittee (pp. 20: 2s.), of Action and Uses Subcommittee (pp. 14: 1s. 6d.) and of Pharmacy Subcommittee (pp. 49: 2s. 6d.). The Pharmaceutical Press, 23 Bloomsbury Square, London, W.C.1.

Valve Conditions in the Internal Combustion Engine

MAINTENANCE of the automobile engine of to-day is little more than a process of periodic adjustment and replacement, necessitated by wear in component parts. Accordingly any systematic study of the factors causing or influencing such wear will be followed with interest by users and manufacturers alike. In recent years, the Research Committee of the Institution of Automobile Engineers, Watergate House, York Buildings, Adelphi, W.C.2, has undertaken the investigation of wear occurring in various parts subjected to the trying temperature conditions existing in and about the combustion zone. This work has been particularly fruitful. Last year the Committee issued a report on "Cylinder Wear" which attracted considerable attention, and now it has published the results of its work on "Valve Seat Wear".

The first part of the present report deals directly with valve seat wear and describes the experimental technique adopted to discriminate between actual wear in the valve seat and distortion of the valve. Two types of valve material were used. With both, the rate of valve sinkage increased rapidly with increase in tappet clearance and, within the practical temperature range, with rise in temperature. In the one case, however, the valve sinkage was mainly due to seat wear, whereas in the other, it was almost entirely attributable to distortion or 'dishing' of the valve head. Tests with different widths of valve seat bring out the fact that wear is quite independent of seat area.

The important effect of temperature prompted an investigation of the factors influencing exhaust valve and seat temperatures. The results obtained are set out in the second part of the report, and show the influence upon valve and seat tempera-

tures of engine speed, length of valve guide, diameter of valve stem, width of seat, fuel and mixture strength, ignition setting, and cooling water outlet temperature. These results are all interesting and some should prove of real practical use. One point to be particularly noticed is the statement that maximum engine temperatures were obtained when using normal mixtures with optimum ignition advance, a result quite contrary to the common belief that retarded ignition and weak mixtures give rise to overheating.

Sound Recording for the Cinematograph

THE improvement in the quality of recorded sound during the past five or six years has been very rapid. During that time the silent film has been almost entirely superseded by the 'talkie' in the cinema. Dr. C. E. K. Mees, in the Sir Henry Trueman Wood Memorial Lecture delivered before the Royal Society of Arts on May 16, said that the introduction of sound recording to the cinema has influenced every part of the motion picture industry. While it will be readily appreciated that the various developments of the mechanisms for recording and reproducing pictures and sound have in themselves been very extensive, striking changes have also been made in other things, such as the design of theatres and the kind of play which may successfully be filmed.

The detail of sound recording and reproduction for the cinematograph may be divided into several sections : (1) Conversion of sound to electrical pulses ; (2) modulation of light intensity by the electrical pulses ; (3) photographic recording of the light fluctuations ; (4) light fluctuations reconverted to electrical pulses ; (5) electrical operation of the loud speaker. Much of this long chain of operations is concerned with electrical apparatus, but the photographic part differs in no essential way from the ordinary procedure of taking a snapshot, making and projecting a lantern slide. Each of the photographic processes calls, however, for very much more accurate control than is necessary for mere picture-making. Very extensive investigations have been made of the whole subject. These have covered many points already broadly understood, but the new work has been necessarily much more thorough.

The influence of the new knowledge gained is manifest in the improved quality of the sound in the theatres : there is less distortion and less 'ground noise'. Of the first of these it can only be said that constant research on the problems of making and matching negative and positive, and studying wave form reproduction, are gradually pushing the quality beyond its already high level. It seems, however, that little reduction in ground noise is to be expected from diminishing the grainy quality of the photographic material ; the presence of minute scratches, dirt particles, etc., which are inevitably formed when the film is handled, is generally more than enough to counterbalance any decrease in graininess. The reduction of ground noise is being accomplished by modifying the recording apparatus so that the influence of flaws on the film is allowed to operate fully only when the sound to be recorded is loudest : the true sound record then masks the trouble.

The researches already carried out have necessitated the construction of much special apparatus and the development of special technique. Now that these are available, progress is likely to be even more rapid.

University and Educational Intelligence

LONDON.—The following degrees have recently been awarded : D.Sc. in chemistry on H. Martin (Imperial College—Royal College of Science) for thirty-one published works on the "Elucidation of the Mechanism of the Toxic Action of Insecticides and Fungicides used for the Control of Crop Pests and Diseases" ; D.Sc. in physiology on Dame Anne Louise McIlroy (University professor of obstetrics and gynæcology at the London (R.F.H.) School of Medicine for Women) for a thesis entitled "Researches upon the Prevention and Treatment of Asphyxia in the New-born" (*Med. J. and Record*, Nov. and Dec. 1933) ; D.Sc. in zoology on Ethelwynn Trewavas (private study) for published works entitled (1) "The Hyoid and Larynx of the Anura", (2) "Enteropneusta", (3) "A Revision of the Cichlid Fishes of the genus *Lethrinops*, Regan", (4) "Scientific Results of the Cambridge Expedition to the East African Lakes, 1930–31. II. The Cichlid Fishes", (5) "A Contribution to the Classification of the Fishes of the order Apodes, based on the Osteology of some rare Eels", (6) "On the Structure of two Oceanic Fishes, *Cyema atrum*, Gunther, and *Opisthoproctus soleatus*, Vaillant", together with three conjoint subsidiary contributions.

THE American system of radio broadcasting was criticised in an address to the Ohio Radio Institute on May 2 by Levering Tyson, director of the National Advisory Council on Radio in Education. The actual situation is that while, from the engineering point of view, there has been remarkable progress, the programmes have no greater cultural value than before 1927 when a licensing authority was established. This authority has tended to crystallise the *status quo* so that the fundamental concept of broadcasting as a public service has been side-tracked and it remains an individualistic enterprise for private gain. The problems of educational broadcasting are no nearer solution than in 1929 when Secretary Wilbur appointed a committee to investigate them, and the number of educational stations has decreased steadily until to-day there are only a few dozen. Mr. Tyson anticipates that an effort will be made by the industry to put its house in order but that advertisement will continue to be its financial basis. He looks for a gradual assumption by the State of responsibility for establishing certain public services within or parallel to the industry but he holds that "you can't force intellectuality down democracy's throat unless it opens wide its mouth. So far its teeth have been tightly clenched". The address is reproduced in *School and Society* of June 30.

EDUCATION in Kent, 1928–1933, is reviewed by the director, Mr. E. Salter Davies, in a report recently published by the County Education Committee. The administrative machinery was subjected to a severe strain in 1931, when expenditure had to be drastically restricted, and withstood the strain well, thanks to the elasticity and resiliency produced by a happy co-operation of its component parts and broad-minded and vigorous leadership. There was a notable *rapprochement* between the educational system and the requirements of industry. One of many instances of this is to be found in the ample provision for

practical work of all kinds now made in the central schools, recently established under the Hadow re-organisation scheme. In these, science teaching has developed on lines that represent a marked improvement on the traditional method of teaching in elementary schools. It is based on the study of everyday phenomena and is therefore influenced more and more by the nature of the occupations of the local community. This method of approach from practice to theory, from the qualitative to the quantitative, is found to vitalise the teaching. Adaptation to local conditions is facilitated by the schools not having to prepare for any set form of examination, efficiency being assessed "by inspection which envisages individual initiative and free development rather than by an examination which would tend to stereotype the instruction given throughout the county". Conditions in the central schools provide, of course, increased opportunity for specialisation accompanied by the assumption by teachers of increased responsibility. So far the results have been wholly satisfactory, especially in attracting teachers of comparatively high qualifications. Among changes in secondary education is the almost complete displacement of botany in girls' schools by biology, which has moreover found a place as part of the general science course in many boys' schools. Thirty pages of the report are devoted to agricultural education, in which Kent is pre-eminent.

Science News a Century Ago

Death of General Paixhans (1783–1834)

On August 19, 1834, General Henri Joseph Paixhans, the distinguished French artillery officer, died near Metz. Born at Metz on January 22, 1783, he passed through the École Polytechnique and, entering the army, eventually rose to the rank of general. He was an experimenter and inventor, and he improved both guns and projectiles, while his views on the armament of men-of-war had a profound influence on the development of the French navy. He was one of the first to explore the possibility of protecting ships with iron armour plates. He wrote several technical works, among the most important of which were his "Nouvelle Force Maritime et Artillerie", 1822, and "Expériences faites sur une Arme Nouvelle", 1825. As a member of the French Chamber of Deputies, he made several important speeches which were afterwards collected and published.

Caledonian Horticultural Society

"The Society intended so to have arranged their annual dinner, as that the competition fruit might have been partaken of by the members of the British Association, who are to meet in Edinburgh on Sept. 7. On mature consideration, however, they found that they could not deviate from the day fixed in their prize list, which had been widely circulated six months before. This day is the 4th of September, and if any of the learned strangers should happen to be in Edinburgh by that time, there is every reason to believe that they will be invited to be present at the Society's dinner. All the gardeners in the neighbourhood are exerting themselves to make a fine display by the time the Association arrive in Edinburgh." (*Edinburgh Advertiser*, Aug. 22, 1834.)

Steam Carriages and Steam Boats

The *Mechanic's Magazine* of August 23, 1834, said: "Mr. Hancock commenced on Monday last running two steam-carriages regularly between the City and Paddington, and they have been plying regularly throughout the week with uninterrupted success. One of Mr. Russell's steam-carriages between Glasgow and Paisley, having been overset by the breaking of a wheel, the boiler burst, and five persons were killed. The Court of Session has, in consequence of this, interdicted the whole set of carriages from running—for the present at least. A fine specimen this of Caledonian wisdom! Why do they not clear the Clyde of the whole of its steamers, since certain it is that steam-boats have met with accidents as well as steam carriages, and are as likely to meet with them again. It is impossible so absurd an edict can stand."

Airy and Greenwich Observatory

In his autobiography Airy says: "On Aug. 25th Mr. Spring Rice [Lord Monteagle] wrote to me to enquire whether I would accept the office of Astronomer Royal if it were vacant. I replied (from Keswick) on Aug. 30th expressing my general willingness, stipulating for my freedom of vote, etc., and referring to my letter to the Duke of Sussex. On Oct. 8th Lord Auckland, First Lord of the Admiralty, wrote: and on Oct. 10th I provisionally accepted the office. On Oct. 30th I wrote to ask for leave to give a course of lectures at Cambridge in case that my successor at Cambridge should find difficulty in doing it in his first year: and to this Lord Auckland assented on Oct. 31st. All this arrangement was for a time upset by the change of Ministry which shortly followed." At Keswick, between August 22 and August 29, Airy records also that he wrote his paper "On the Calculation of Perturbations" for the Nautical Almanac.

The 'Magneto-Electric' Spark

On August 25, 1834, Faraday wrote in his Diary: "To-day procured the Electric spark from a Magnet directly, i.e. used no soft iron lifter or intermediate magnet". He described an experiment with a cylindrical bar magnet and a coil of wire wound on to part of a pasteboard tube, in which a wire from one end of the coil made contact against a small amalgamated metal plate attached to the other end, and the magnet, on being driven through the tube, separated the wire from the plate and a spark resulted. "The Electricity here is much more directly from the magnet than in the usual way of procuring a spark."

The entry needs some explanation. Faraday depended greatly on the spark as a means of showing that the induced currents he had discovered in 1831 really were electricity, having the same properties as that from a voltaic battery or frictional machine. At the time of reading of the First Series of the Experimental Researches in November 1831, he had succeeded in obtaining the spark by induction only with the iron ring and wire coils used in his original experiment of August 29. It was not until February 1832 that he found a way of producing it with a permanent magnet, by bringing the ends of an iron core, surrounded by a wire coil the ends of which were touching, down on to the poles, when a spark resulted at the contact of the wires. Now, in August 1834, he had eliminated the iron core and obtained his spark with magnet and coil alone.

Societies and Academies

Dublin

Royal Irish Academy, June 25. SEÁN P. O. RIORDÁIN: Recent acquisitions from Co. Donegal in the National Museum. The paper deals with more than one hundred acquisitions obtained from Co. Donegal by the National Museum of Ireland during a period of about five years. Many of the Donegal finds were shown to be of unusual types in Irish archæology and gave evidence of interesting connexions with other lands, the relationships with Scotland being particularly close. Several new burial-finds were described, and in a résumé of bronze age burials a total of eight hitherto unpublished finds of food-vessels was brought to notice. Other discoveries of outstanding interest were a find of 108 amber beads (some with double perforation for use as 'spacers'); a socketed bronze axe with an arrangement of circle and pellet ornament similar to Scottish examples; an unusual type of flat bronze dagger, and a remarkable large stone axe. From the later period a find of three silver bracelets of Norse workmanship was dealt with in connexion with similar finds from Great Britain and the Continent and with regard to the evidence of ancient silver mining in Ireland. JOSEPH ALGAR and K. J. HANWAY: Further studies in the synthesis of diflavones. β-Diketones derived from diacetoresorcinol-dimethyl ether may be prepared by condensing the latter substance with aromatic aldehydes in the presence of alcoholic sodium hydroxide to form dichalkones, such as dibenzylidene-diacetoresorcinol dimethyl ether. These dichalkones, by addition of bromine, form tetrabromides and the latter, when heated with methyl alcoholic sodium methylate followed by treatment with hot aqueous hydrochloric acid, are converted into β-diketones of the type dibenzoylaceto-resorcinol dimethyl ether. While the procedure described affords a convenient route for the synthesis of β-diketones from diacetoresorcinol dimethyl ether, attempts to prepare diflavones from the diketones by the action of hot concentrated hydriodic acid, were not uniformly successful. In some cases the analytical results appeared to indicate that ring closure had occurred on one side only of the central nucleus and that the action of the hydriodic acid had resulted in ketonic hydrolysis of the second diketone grouping with the production of a monoflavone of the type 4′·7 dihydroxy-6-acetyl-flavone.

Paris

Academy of Sciences, June 25 (*C.R.*, **198**, 2217–2312). V. GRIGNARD: The method *par entraînement* for the preparation of mixed organomagnesium compounds. Experimental evidence is given proving that the functional exchange discovered by Prévost and studied more recently by Urion is quite insufficient to explain the phenomenon recently described by the author and named by him the method *par entraînement*. PAUL LANGEVIN was elected a member of the Section of Physics in succession to the late P. Villard. J. GERONIMUS: Some extremal properties of trigonometric polynomials. M. LÉVY: Selective transformations. Application to the analysis of mixtures of sinusoids. CAÏUS JACOB: Some generalised problems of Dirichlet-Neumann for multiply connected areas. RENATO CACCIOPPOLI: Double integrals of Cauchy, and generalised monogenic functions. PIERRE VERNOTTE: The control of the regularity of graduation of a thermometer. The method is based on the determination of the rate of cooling of a calorimeter vessel surrounded by a water jacket of constant temperature. MARCEL SCHWOB: The dispersion and thermal variation of the electrical double refraction of some optically active liquids. Ethyl and butyl tartrate were examined. These liquids have zones of abnormally rapid variation of the electric double refraction with temperature. In the case of ethyl tartrate, Langevin's law does not appear to be obeyed between 4° C. and 15° C. HENRY DE LASZLO: The determination of the structure of the free molecules of tetrabromo- and tetraiodo-pentaerythrite by the diffraction of electrons. L. ABONNENC: The diamagnetism of the ions. B. DECAUX and J. B. GALLÉ: Fluctuations in the time of propagation of short radio-electric waves. In the experimental arrangement described any variation in time over the journey Paris to Algiers and back was shown by a variation of the Lissajous figure on the screen of an oscillograph. During the day this figure remained stable, but at night the Lissajous figures continually changed in shape, sometimes so rapidly that it was impossible to follow them. The variations indicated a difference of time of more than 0·001 sec. over a total time for the double journey of 0·01 sec. ANGLA: Citronnellol-rhodinol. JEAN JAFFRAY: The origin of the high-frequency oscillations produced by high-tension magnetos. W. SWIETOSLAWSKI: The degree of dehydration of binary azeotropes. This can be measured by determining the difference between the temperatures of boiling and condensation. Quantities of water not exceeding 10^{-5} gm. per gm. of mixture can be detected in this way. AUGUSTIN BOUTARIC: The mechanism of the ascent of colloidal solutions in porous bodies. GUY GIRE and ALFRED MOTAIS DE NARBONNE: The action of magnesium on solutions of nickel chloride. E. VELLINGER and G. MULLER: The oxidation of mineral oils by atmospheric oxygen at moderate temperatures. The quantity of asphaltic products formed from mineral oils during the heating in presence of copper is proportional to the time of heating and to the quantity of copper dissolved in the oil. MLLE. BLANCHE GREDY: The study of some acetylene ether oxides. Study of Raman spectra of compounds of the type $R.C \equiv C.CH_2OCH_3$. MARCEL SOMMELET and ISRAËL MARSZAK: Chlormethyl compounds derived from the phenols. OCTAVE BAILLY and JACQUES GAUMÉ: The migration of the phosphoric radical in the course of the hydrolysis of the α-methylglycerophosphoric diester. The passage from α- to β-glycerophosphates. CH. COURTOT: Study in the diphenylene sulphide series. WIEMANN: The hydrogenation of a mixture of two α-ethylenic aldehydes. CHARLES PRÉVOST and RENÉ LUTZ: The reaction of the iodo-argento-benzoic complex on the erythrenic hydrocarbons. V. AGAFONOFF: The question of the buried soils of Alsace. J. JUNG: The position of the rhyolitic tufas of the Sioule (Puy-de-Dôme) valley and the ante-Hercynian age of the gneiss and granites of the north-west part of the Central Plateau. L. CLARIOND: The Palæozoic series of the territories of Tafilalelt (Morocco). CH. POISSON: The evolution of tropical tempests. Discussion of the laws governing tropical storms and the possibility of their prediction. CH. CHABROLIN: The germination of the seeds of *Orobanche*. J. GIAJA and S. GELINEO: Nutrition and resistance to cold. MLLE. A. ARVANITAKI and H.

CARDOT: The interpretation on a common base of myocardic electrograms. ET. RABAUD and MLLE. M. L. VERRIER: Retinal excitability and reflex immobilisation in birds. W. KOPACZEWSKI: Lacto-gelification of the seric proteins. MLLE. A. MICHAUX: The proportions of calcium and magnesium in the brain of guinea-pigs either normal or attacked with acute scurvy and chronic scurvy. G. DELAMARE: Numerical values of some primary sinusoids with unequal loops of the body of the Spirochetideæ. HENRI B. REITLINGER: A phenomenon of supersaturation of warm water.

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 2, No. 1). A. GELFOND: On the seventh problem of D. Hilbert. B. DELONE: Fermat's theorem for $n = 3$. A. I. POPOV: On some definite integrals with cylindrical functions. V. D. KUZNETSOV and V. A. ZOLOTOV: On the mechanical formation of twins during recrystallisation of deformed zinc single crystals. V. M. CHULANOVSKIJ and M. P. MOKHNATKIN: Fine structure of the triplet $(2s^2)\ (2p)\ 3s^3\ \varphi \rightarrow (2s^2)\ (2p^2)^3\ \varphi$ of the carbon atom. M. M. KATZNELSON and M. S. KONDAKOVA: 1-Ethyl-2-methyl-valerian acid. Description of properties of the acid. A. KHARIT and N. KHAUSTOV: Oxidation and reduction processes in a working muscle (3). Glutathione in a working muscle. During work, a muscle retains the glutathione which becomes reduced, while it is dispersed by a resting muscle. The oxidised glutathione is carried away by blood both from a working and from a resting muscle. E. HASRATIAN: The influence of an unconditioned food reflex upon the corresponding conditioned reflexes. The unconditioned reflex exerts an inhibitory influence upon conditioned reflexes during a certain period after it has ceased to act; this inhibition is apparently of the nature of induction. A. SEREBROVSKIJ: The properties of Mendelian equations. Since the equations widely used in genetical literature have no algebraical meaning, the author suggests a new scheme for expressing genetic processes by formulæ constructed according to algebraic rules. The equations formed in this way may be solved algebraically, which would assist materially in the solution of various genetical problems. N. POTAPOV and N. STANKOV: Periodicity of mineral nutrition within the twenty-four hours. The rate of absorption of nitrates by Indian corn is determined by the intensity of the internal processes in the root system, particularly by the breathing activity of the root cells. During the night, the energy of breathing and the absorption of mineral substances increases, by day it decreases. N. UDOLSKAJA: Contribution to the study of the elements of mineral nutrition as factors altering the drought resistance of plants. The action of phosphorus on plants consists largely in increasing the water-retaining capacity of the plasma, thus ensuring a normal course of assimilation under conditions of deficient moisture. G. MOLOTKOVSKIJ: A gelatin chamber for a porometer. G. NADSON and E. STERN: The action of ultra-violet rays of a quartz mercury lamp on the cell of *Bacillus mycoides*, Fl. The rate of development is increased, and a rapid ageing of the cells results. P. MURZAJEV: Mineralogical and geochemical prognoses. The basis of a prognosis concerning the industrial value of a mineral deposit is formed by studying the type of the deposit, the paragenesis of the mineral concerned, and the chief temperature moment in the formation of the mineral body. N. A. GLADKOV: The distribution of ornithological stations on a lake in the plains. The following four stations should be distinguished: water area; waterside shallows; shore waterside thickets; and shore itself.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 145–219, March 15, 1934). A. J. WATERMAN: Survival of young rabbit embryos on artificial media. A limited amount of growth and differentiation of embryos of the late primitive streak and two somite stages was obtained by incubation on two culture media, one containing nutrient gelatin and the other Loeffler's coagulated blood serum. CHARLES E. ALLEN: A diploid female gametophyte of *Sphærocarpos*. The involucres of a specimen of *Sphærocarpos* bore an unusually large number of appendages. The spore-tetrads produced, instead of the usual two males and two females, three or even four female-producing spores. This line is diploid, with 2 X-chromosomes and 14 autosomes. CHESTER STOCK: A second Eocene primate from California. Parts of jaw bones and teeth belonging to a primate allied to *Washakius* have been found in the Upper Eocene in the Scope deposits of southern California. MORTON D. SCHWEITZER: Coincidence and interference in *Drosophila melanogaster*. C. W. METZ: The rôle of the 'chromosome sheath' in mitosis, and its possible relation to phenomena of mutation. Under favourable conditions, chromosomes are seen to be surrounded by a transparent and apparently gelatinous sheath. The author believes that this sheath is a characteristic structural component of all chromosomes. It is suggested that its function is to 'insulate' the chromosome proper and to prevent it from coming into direct contact with other formed bodies in the cell, including other chromosomes. Irradiation, which increases the rate of mutation, may act by modifying the sheath in such a way as to permit intimate contacts between chromosomes. D. C. COOPER: Development of the embryo sac of *Lilium Henryi*. RICHARD M. BADGER and ROBERT C. BARTON: The ultra-violet absorption spectrum of carbon suboxide gas. In a perfectly clean quartz vessel the gas keeps well especially at low temperatures. Keeping the absorption cell at room temperature, carbon suboxide shows relatively strong absorption bands between λ3200 and λ2500, and a continuum overlying the bands. The bands are due to transverse oscillations of the molecule and their complexity indicates several vibrational levels of nearly the same energy. RICHARD C. TOLMAN: Effect of inhomogeneity on cosmological models. A theoretical discussion of very simple models composed of dust (nebulæ) exerting negligible pressure and distributed non-uniformly but with spherical symmetry around some particular origin. The discussion may be valid in our own neighbourhood (out to, say, 10^8 light years) and over a limited range of time (say, 10^8 years) but does not necessarily apply to the universe as a whole. R. B. LINDSAY: Elastic wave analogies to the motion of electrons in force fields. HENRY BORSOOK and GEOFFREY KEIGHLEY: A theory of protein metabolism in man. Even in a state of nitrogen equilibrium, most of the protein metabolised in a day is drawn from 'stores' in the body. The specific dynamic action of protein is composed of two factors: (a) metabolism of the

nitrogen, a constant which is observable at temperatures below 20° C. when 'chemical' heat regulation mechanism is in operation; and (*b*) metabolism of deaminised residues, a variable factor which comes into operation above 20° C., when body temperature is governed by 'physical' heat regulating mechanisms. NORMAN C. WETZEL: On the motion of growth. (8) The connexion between growth and heat production in the amphibian *Bufo vulgaris* from fertilisation to metamorphosis. Gayda's observations (1921) on growth and heat production of this animal lead to a differential equation of growth similar to that obtained for a human being from early fœtal to adult life and for bacteria. It is claimed that this form of equation can be used quite generally to determine the relationship of growth to metabolism in any organism. EDWIN B. WILSON and JANE WORCESTER: The resolution of four tests. EDWIN B. WILSON: On resolution into generals and specifics. M. H. STONE: Boolean algebras and their application to topology. A Boolean algebra is defined by a set of postulates in terms of (logical) addition and (logical) multiplication as undefined operations. Various theorems are developed and it is shown that there is complete mathematical equivalence between the theories of Hausdorff topology and Boolean algebras. G. A. MILLER: Groups whose squares constitute cyclic subgroups. S. BOCHNER: Average distribution of arbitrary masses under group translations. G. VALIRON: Entire functions and Borel's directions. TRACY YERKES THOMAS: The reduction of degenerate quadratic differential forms.

Official Publications Received

GREAT BRITAIN AND IRELAND

The Botanical Society and Exchange Club of the British Isles. Report for 1933 (with Balance Sheet for 1933) by the Secretary, William Harrison Pearsall. Vol. 10, Part 3. Pp. 461–745. 10*s*. Report for 1933 of the Botanical Exchange Club, by the Editor and Distributor, F. Rilstone. Vol. 10, Part 4. Pp. 747–780. 4*s*. (Arbroath: T. Buncle and Co.)

City of Leicester. Science and its Applications: a Select List of Books in the Central Reference and Lending Libraries, Leicester. Pp. vi+65. (Leicester.)

Quarterly Journal of the Royal Meteorological Society. Vol. 60, No. 255: The Phenological Report, 1933. Pp. 197–250. (London: Royal Meteorological Society.) 3*s*.

Rothamsted Conferences. 17: Modern Changes in the Treatment of Light Soils; being the Report of a Conference held at Rothamsted on March 20th, 1934, under the Chairmanship of Sir E. J. Russell. With Contributions by Sir E. J. Russell, A. J. Hosier, W. Parker, A. W. Oldershaw and Dr. H. H. Mann. Pp. 34. (Harpenden: Rothamsted Experimental Station.) 2*s*.

The Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1934. Pp. 19+2 plates. (Kirkhill, Ayr.)

The National Central Library. 18th Annual Report of the Executive Committee, 1933–34. Pp. 53. (London: National Central Library.)

Board of Education. Report of the Advisory Council of the Science Museum for the Year 1933. Pp. 47+1 plate. (London: H.M. Stationery Office.) 9*d*. net.

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Social Aspects of Labour and Leisure

THE picture of labour displaced by machinery drawn by Sir Frank Smith in his recent Gustave Canet Memorial Lecture before the Junior Institution of Engineers was one of the most impressive features in his account of the function of the engineer in modern civilisation. The striking examples he cited of the way in which machinery is making it possible for the same output to be achieved by fewer and fewer workers could easily be multiplied, and the consequent growth in the volume of technological unemployment is one source of what has been described as the revolt against mechanism. Few, however, who are familiar with the automatic signals which have so largely replaced the traffic control policemen, or the signalmen on the Underground railways, give a thought to the unemployment aspects of such changes. Fewer still perhaps realise the effect of the growing use of mechanism in offices on the volume of clerical labour, but it is in such ways as these, as much as in the more sensational developments in agricultural or industrial machinery, that machinery, and especially power production, is affecting the whole aspect of our civilisation.

It is, of course, easy to overstress this aspect and to draw unsound deductions from such displacements of labour. Leaving out of account such questions as the liberation of human labour in this way from tasks making peculiarly severe or unpleasant demands in health and energy, the process of reducing the ratio of men employed to output has been repeatedly accompanied by an expansion in output many times greater, so that the total labour employed may be three or four times as great as before.

There are, however, signs that this position is changing and that expansion in this way in future will be limited. Moreover, here again it is not easy to obtain a true picture without considering the effect of expansion upon other industries. Development in one direction so often means restriction and diminished employment in another that the final result may be much less satisfactory than would at first appear. The ill-effects of the unbalanced development of industry have been, indeed, one weighty factor in the pleas for the national planning of industry which have been brought forward in recent years. Apart from this, it is clear that rationalisation and mechanisation alike are unable to prevent periodic unemployment or recurrent severe economic crises.

On these grounds alone, public opinion is coming to demand that the social consequences of mechanisation shall receive study as well as its narrower industrial and economic aspects. This view is powerfully reinforced by the contrast between the large volume of unemployment and its concurrent distress and impoverishment of life, and the overproduction and sabotage which have been common in many parts of the world. It is further supported by the effects of mechanisation itself on those actually engaged in production. Studies directed towards the improvement of industrial efficiency have indicated, for example, the detrimental effect on the workers of monotonous repetition in mechanical processes, but even more serious are the signs that mechanical habits are spreading from working hours to hours of leisure or amusement. Many have, indeed, largely lost the power to amuse themselves, and avoid boredom only by resorting to mechanical forms of amusement closely related to the mechanical conditions which dominate their working hours.

If we are becoming acutely aware of the dominating power which machinery has acquired in our whole lives, and of its social as well as its industrial consequences, we are becoming aware also, though more slowly, of our mechanical habits of mind. It is this, indeed, that constitutes our chief danger. It has infected our educational system, which often tends to repress rather than to encourage originality of thought or purpose. It has spread through science itself, which is a great user as well as a deviser of machinery. The very dependence of the modern scientific worker upon technique, no less than the premature and intense specialisation to which he is often condemned, encourages mechanical mindedness ; and important sections of modern science are essentially affairs of machine-minding, even if exceptional accuracy of observation and skill in experimenting or recording results are required therein.

There is in fact a general absence of creative thought ; and accordingly our mechanical mindedness has diverted energies, which are needed for the adventures of regaining control and utilising to the full the new forces at our disposal, into the pursuit of a security for life and happiness based on the assumptions of an era that has passed. In the revolt against the present dominance of mechanism, the beginnings of which may be discerned alike in science and in politics, there is at times a sense of the futility of machines, particularly when the unemployment situation is considered, which finds expression in approval of the action of the people of Erewohn. Only our mechanical mindedness can betray us into such a false position. If, as Prof. Whitehead suggests, "Life is an offensive against the repetitive mechanism of the universe", the aim of that offensive is, as Dr. L. P. Jacks points out, not the destruction of mechanism but its capture, mastery and use for the creative purposes of life.

The very magnitude of unemployment in the world to-day is bringing us to a wider vision and to more creative thought about the situation. It is more and more seen that unemployment is bound up with the general problem of leisure, and that the whole question is one of distribution—how the resources which power production have placed at our disposal can be used to raise the whole standard of living, so that, with the expenditure of effort which leaves him free to enjoy his leisure hours, man can satisfy his wants in ways that have been possible only for the few in the past, and can achieve standards of health and fitness which have hitherto been beyond his reach.

The belief that this paradox of deprivation and want in the midst of abundance is removable if we utilise our resources is steadily gaining acceptance. It is challenging the old assumptions of economic systems regarding the exchange and distribution and production of goods. Much creative thought as well as scientific study are undoubtedly essential if we are to find the solution we desire, but mere mechanical thinking is likely to perpetuate the conditions of the past until worse confusion arises.

This very attitude holds an element of hope which elsewhere is lacking. When we are prepared to adventure in life in this way, the possibility of recreation arises, and the acceptance of change, or rather the expectation of change which is an essential part of the scientific attitude to life, is one of our fundamental needs. The realisation that mechanism can be used for a larger freedom—that while it enslaves our working hours it should shorten the hours of that slavery and lengthen the hours when we are free men—confronts us with an opportunity to recover in our leisure hours all the freedom, the spontaneity and the joy which is thwarted or smothered in working hours. The estimate quoted by Sir Frank Smith that the harnessing of coal, oil and electric power in the service of man has placed at the disposal of every individual in the United States of America an

average of 900 mechanical slaves, on the moderate assumption that one horse power is equivalent to the power of 10 men, gives an impressive but suggestive idea of the resources which we have at our disposal but have scarcely commenced to utilise effectively.

A vision of the resources with which science has endowed us and the realisation that now and now only, as Sir Arthur Salter points out, "our material resources, technical knowledge and industrial skill are enough to afford to every man of the world's teeming population, physical comfort, adequate leisure and access to everything in our rich heritage of civilisation that he has the personal quality to enjoy" should supply the stimulus to the creative thought and courageous and magnanimous action required. To secure such advantages revolutionary changes in our customary and accepted attitude to distribution, production, work and leisure may well be required, and the control of many sectional and selfish interests, realising that in the long run the common interest is the true interest of each individual.

The aspects of technological unemployment upon which we have touched emphasise indeed the necessity for a new outlook on this situation. Labour and leisure have been separated too rigidly both in thought and in practice, and industrial psychology has only begun to demonstrate to us some of their many important interactions. Even from the point of view of industrial efficiency, we are compelled to take account of the opportunities which leisure affords of repairing the human damage which may have resulted from the pace of mechanisation of industrial operations. The prospect of shorter hours of labour and ampler leisure for all, however, are impelling us to a wiser and surer point of view which regards work and leisure as interdependent, as complementary aspects of life as a whole, neither of which can be enjoyed to the full while the other is defective. The conception of leisure as affording opportunities for recreating life—for liberating and vitalising it—is one to which comparatively few have paid attention, but it represents one of the most important problems which mankind has to face. The readjustments in society made necessary through the increased powers with which science has endowed man can never be realised until man has learnt to utilise his leisure hours as effectively as his hours of labour. The conception of leisure implicit in the word 'vacation' must be replaced by that implicit in 'recreation'; and to achieve this, education must be directed as consciously towards the preparation for leisure as for industry. Rather it would be true to say that education must learn to combine preparation for work and preparation for leisure in a harmony which is better described as preparation for citizenship or for living.

This conception of life as a whole is one which should appeal instinctively to scientific workers, who indeed stand as much in need of its liberating and vitalising influence as any section of the community. Scientific thought must make an essential contribution to the creative thinking which is demanded if we are to gain the control of the machines and use them for our purpose without being dominated by them. The new era of orderliness will not come of itself. Our task of reconciling industrial and social practice with revised scientific thought will not be achieved without courage and vision. It may issue in a new economic structure for society which as yet we are unable to predict. No scientific worker who has glimpsed the possibilities which machine power has put within our grasp can, however, turn aside from the task of assisting society to avert the evils with which mechanisation threatens us, and to translate those possibilities into achievement, without disloyalty to that spirit of adventure and honest endeavour which is an essential part of the scientific spirit itself.

Valency Types and Problems

(1) *Some Physical Properties of the Covalent Link in Chemistry.* By N. V. Sidgwick. Pp. vii+249. 10*s*. net. (2) *Hydrides of Boron and Silicon.* By Prof. A. Stock. Pp. x+250. 9*s*. net. (The George Fisher Baker Non-resident Lectureship in Chemistry at Cornell University, Vols. 11 and 12.) (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1933.)

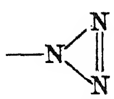
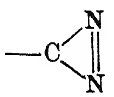
(1) DURING the past ten years, Dr. Sidgwick has built up a reputation, which is perhaps unique amongst chemists, as a reporter whose judgments are based upon an exceptionally wide knowledge of chemical facts and a keen appreciation of the significance of physical theories in their interpretation. He has, moreover, the courage of his convictions, and does not hesitate to express the results of his own independent thinking, even when they are not in agreement with the views held by his colleagues. The publication of these lectures, which he delivered at Cornell

during his tenure of the George Fisher Baker lectureship, gives to chemists in general the privilege of sharing in a type of instruction which must obviously have been very stimulating to his hearers in Cornell, as well as to his regular classes in Oxford.

It is no disparagement to the experimental work which is cited in these lectures, to say that their interest depends largely on the opportunity which they provide of hearing (or reading) the considered judgments of the author on topics which have recently been or still are in the region of controversy. One such topic is the structure of carbon monoxide. As Langmuir has pointed out, this gas resembles nitrogen very closely in its physical properties, since it can be derived from it by transferring one unit of positive charge and two units of mass from one nucleus to the other. This gives rise to the formula

$$\overset{+}{C}\equiv\overset{-}{O}\ ;\ \text{compare } N\equiv N.$$

Objections to this formula could be raised on the ground that the electric charges on carbon and oxygen would make the gas differ widely from nitrogen, where the atoms are neutral. Sidgwick points out that these charges serve to neutralise the strong dipole moment of the $>C=O$ group, and that the absence of any strong polarity in carbon monoxide is therefore an argument in favour of the formula. On the other hand, in the controversy as to the structure of the azides and aliphatic diazocompounds, Sidgwick records a verdict in favour of the older cyclic structures:

 and 

These are inadequate to explain the optical activity which has been recorded in certain aliphatic diazo-compounds, since this can only be explained by using a linear formula of the type

$$>\overset{-}{C}-\overset{+}{N}\equiv N\ ;$$

but he regards the evidence for optical activity in these compounds as inconclusive.

An explanation of the cyclic structure of the azides, as contrasted with the linear structure of the azide ion $\overset{-}{N}=\overset{+}{N}=\overset{-}{N}$, can be found in the fact that the central atom of the ion already carries 8 shared electrons and cannot therefore form covalent derivatives by electron-sharing.

More fundamental is the problem provided by the contrast between covalence and electrovalence, for example, in compounds such as

$$Cl-Cl \text{ and } \overset{+}{K}\overset{-}{Cl}.$$

Is there after all any real difference between these two types of valency? May they not be merely limiting cases, which can be bridged by a series of intermediate stages, in such a way as to make it impossible to find any sharp boundary line between them? Fajans has adopted this view, and has cited evidence in support of a continuous transition from one type to the other. The reviewer, on the other hand, has always wanted, if only as a matter of practical convenience, to maintain a contrast which has done so much to clarify the theory of valency and to reconcile the diverse views which had previously been held by inorganic and organic chemists respectively. Many of the intermediate stages can be explained by the variable readiness with which a covalent molecule can be ionised, leading in the case of weak electrolytes to a statistical equilibrium between a covalent molecule and its ions; but it has been left to Sidgwick to give the most complete vindication that has yet been made of this convenient hypothesis.

This vindication includes a theoretical discussion, leading to the conclusion that the formation of an intermediate type of link, which is neither a covalence nor an electrovalence, "is not likely to be of frequent occurrence"; and this conclusion is supported by experimental evidence, under eight different headings, showing how sharp is the distinction that can be drawn between salt and non-salt. On the other hand, he rejects the symmetrical formula for benzene, with its system of three-electron bonds, and is not convinced by Sugden's arguments for widely-distributed one-electron bonds. He therefore brings very powerful support to those who hold that, apart from a few exceptional cases in odd-electron compounds and the like, there are two kinds of valency and two only, which can be invoked by chemists to explain the phenomena of chemical combination.

The topics cited above have been selected from an orderly review of the properties of the covalent bond, in which its length and heat of formation are discussed, as well as the directed character of the bond, which gives rise to the phenomena of stereochemistry; and, in view of the importance of the work on dipole moments which has been

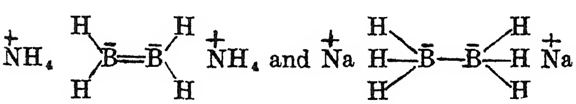
done at Oxford, it is not surprising that the longest chapter of the book is given to this subject. This orderly review provides pleasant reading, and is a contribution of real value to the progress of chemistry in one of its most fascinating periods of development.

(2) Prof. Stock's Cornell lectures consist largely of a record of laborious and painstaking preparative and analytical work on the hydrides of silicon and boron. They bear tribute to the patience and skill of the author, as well as to the perversity of the materials which he had to manipulate. The anomalous behaviour of the hydrides of boron has, however, provided a series of difficult and fascinating problems and has thus placed these elusive compounds in the forefront of many discussions of the theory of valency.

The known hydrides are of two series:

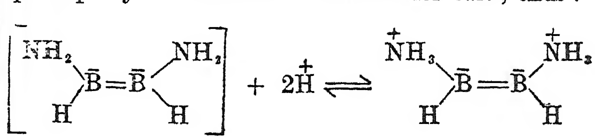
(i) B_nH_{n+4} : B_2H_6, B_5H_9, B_6H_{10}, $B_{10}H_{14}$.
(ii) B_nH_{n+6} : B_4H_{10}, B_5H_{11} and perhaps B_6H_{12}.

In each case increments of BH are recorded; but no hydride containing *one* or *three* atoms of boron is known. In particular, there is no monomeric BH_3 to correspond with BMe_3; and the structure of the dimeric B_2H_6 presents a perpetual puzzle, in view of the fact that there are two electrons less than the number which just suffices to provide the single bonds between the atoms in C_2H_6. Much ingenuity has been exercised in deciding which two electrons can be kidnapped with least risk of the loss being detected; but no final conclusion appears to have been reached. The author himself adopts a different procedure, since he assumes with Christiansen (1927) that diborane, B_2H_6, corresponds in structure and properties with ethylene, C_2H_4, rather than with ethane, C_2H_6, and accepts the formula which Wiburg in 1927 proposed on these lines. On this basis it is easy to account for the formation of a bivalent ammonium salt, B_2H_6, $2NH_3$ or $2[NH_4]^+[B_2H_4]^{--}$, and of a disodium derivative, $B_2H_6Na_2$, since these can be formulated as

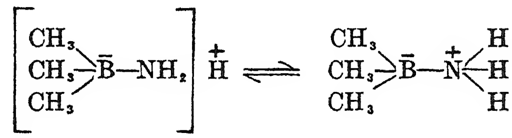


The parent compound, in which $\overset{+}{N}H_4$ is replaced by $\overset{+}{H}$, however, is more difficult to formulate, since the two acidic protons can scarcely be kept 'outside the bracket' $[B_2H_4]H_2$ and must presumably be allowed to nestle close to the negatively charged atoms of boron, even if no electrons can be spared to hold them by covalent bonds.

In any event, it seems to be clearly established that two of the hydrogens differ from the other four in being acidic, and electrolysis of solutions in liquid ammonia confirms the deductions made above, since the main effect is a replacement of two non-acidic hydrogens by NH_2 radicals, followed perhaps by the formation of an 'inner salt', thus:

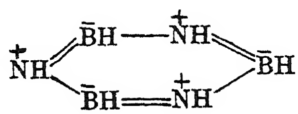


A similar 'inner salt' structure may be recognised in the compound $B(CH_3)_3$, NH_3, which is formulated as follows:



The higher homologues of this series also form analogous compounds with ammonia, such as B_4H_{10}, $4NH_3$ and $B_{10}H_{14}$, $6NH_3$, indicating the presence of four and six acidic protons.

Another interesting and remarkably stable compound has the composition $B_3N_3H_6$. This appears to be the analogue of benzene and can be formulated as



where the double and single bonds can be interchanged, exactly as in Kekulé's formula for benzene.

These problems of valency lend a peculiar interest to certain sections of the book, but its main value is to be found in the fact that it summarises the contents of 69 papers by the author, and 15 by other workers, references to which are given both in the text and in a bibliography at the end of the book. T. M. Lowry.

Everyday Psychology

Psychology and Psychotherapy. By Dr. William Brown. Third edition. Pp. vii+252. (London: Edward Arnold and Co., 1934.) 12*s*. 6*d*. net.

The present edition of Dr. Brown's "Psychology and Psychotherapy" has been so extensively revised and enlarged that it is virtually a new book. Dr. Brown is enthusiastic about the future of psychology; in his opinion it is destined

to become an essential part of the equipment of every educated person. Hence his endeavour to present an outline of our present knowledge in a practically useful form. The list of contents, ranging as it does from a description of simple war neuroses, through a consideration of the relation of mind to brain, up to the question of "Eternal Values", shows how wide is the scope of Dr. Brown's purview. He wisely avoids academic discussion of the details in which rival schools differ from one another, but indicates his own views and supports them by illustrative cases from his personal experience. Dr. Brown maintains his position regarding hypnosis and suggestion, and argues that the 'normal' individual can be helped by appropriate formal suggestion and autosuggestion. Indeed, in his opinion, autosuggestion can and should be used as a process of mental development. He is also a firm believer in the beneficial effects of the abreaction of repressed emotions.

Although not subscribing to the whole Freudian doctrine, Dr. Brown fully acknowledges the enormous advances which Freud's researches have brought about, and he deplores the inaccuracies and misunderstandings with which popular prejudice has confused them. Many of these misunderstandings he attributes to difficulties of terms rather than of fact, and he therefore devotes some space to an elucidation of Freudian terminology.

From his experience with the War psychoneuroses, Dr. Brown shows that the earlier such patients come under treatment the greater is the prospect of success. As this applies also to cases of "functional nervous disorders" occurring in civil life, it is important that a general practitioner should diagnose the nature of the trouble and put his patient under suitable treatment in the earliest stage.

Alcoholism and drug addiction are recognised as attempts on the part of certain neurotic personalities to escape from life's difficulties, but space does not permit the author to deal adequately with this specialised section of the wide field he seeks to cover. This inevitable limitation is noticeable in other chapters, but the purpose of the book is nevertheless well served in that it emphasises the psychological factors in many of the problems of everyday life, where until recently they had been overlooked or at any rate under-estimated.

Dr. Brown is among those who hold the ideal that the training of every doctor should be such as will enable him to treat his patients psychotherapeutically at the same time as physically. His discussion of the psychology of the adolescent will be found valuable by those who are called upon to help maladjusted or wayward individuals through this critical period of life. Here as elsewhere Dr. Brown insists upon the importance of the personal factor; the sincerity and human sympathy of the healer. In his experience everyone is at heart religious and needs a philosophy of life. It is the duty of a healer to help the patient towards the attainment of this by integrating his personality to the utmost.

Dr. Brown is to be congratulated on the clear and broadminded way in which he has, in this little book, supplied a wholesome corrective to the present-day materialistic attitude to life.

A. E. CARVER.

Fifteenth Century Physic

A Leechbook: or Collection of Medical Recipes of the Fifteenth Century. The Text of MS. No. 136 of the Medical Society of London, together with a Transcript into Modern Spelling, Transcribed and edited with an Introduction, Notes and Appendix by Warren R. Dawson. (Published for the Royal Society of Literature of the United Kingdom under the Terms of the Dr. Richards Trust.) Pp. iv+344. (London: Macmillan and Co., Ltd., 1934.) 20*s*. net.

THE Medical Society of London was founded in 1773 and has possessed since its earliest days MS. No. 136, which Mr. Warren Dawson has now transcribed and rendered into modern English, the original text and the twentieth century version being conveniently printed on opposite pages throughout the book.

The medieval compiler of this collection of recipes provides a rich supply of common names of herbs, on which the editor, very wisely, says that even in the Middle Ages the identification of plants and minerals in medical manuscripts must have been a matter of the greatest complexity, and that the glossaries and nomenclators then drawn up giving the synonomy of herbs "often increase rather than diminish our difficulties". Point is given to this comment by the recent efforts of correspondents of the *Times* and the *British Medical Journal* to give botanical precision to 'cow parsley' and to 'ground ivy' respectively.

In spite of his cautionary remarks, Mr. Dawson does provide a number of identifications. 'Cokyll' occurs as an item in these recipes and is modernised by Mr. Dawson as 'cockle (ergot)'. This raises two interesting points. 'Cockle' generally means, not

ergot, but 'corncockle' (*Lychnis Githago*). Further, Flückiger and Hanbury ("Pharmacographia") and Barger ("Ergot and Ergotism") agree in giving 1582 as the date when ergot was first definitely referred to as a drug. The editor puts the date of MS. 136 about the middle of the fifteenth century, possibly 1443–44, so that if 'cokyll' is really ergot, this reference is more than a century earlier than that usually accepted. Medieval names for diseases also present difficulties. The editor explains in a footnote that "the fire of hell that burneth in a man's flesh" is "also called wildfire and St. Anthony's fire (erysipelas)". The critical summary of the literature provided by Barger (loc. cit.) seems, however, to leave little doubt that the St. Anthony's fire of the Middle Ages was not erysipelas but the gangrenous form of ergotism.

The early purveyors of medicine seem to have had an instinctive belief in the therapeutic efficacy of anything nasty. That is generally true of this collection of recipes, though a few of them might be described as "sugar and spice and all that's nice", for example, that "for the cough, a precious drink, and for the breast, and is called metheglin, and also wine of Tyre or Tiberias and this is the perfect [method of] making" (p. 89): it is a decoction of thirty-seven herbs, sweetened with honey and fermented, the fermented liquor being finally flavoured by maceration with a mixture of nine kinds of spice. Some of these spices, for example, cloves, pepper, nutmegs, mace and ginger, must have been hard to come by in fifteenth century England.

Though the familiar jibe "Any green thing that grew out of the mould was a wonderful herb to our fathers of old" can be levelled with truth at most of the items in these recipes, some of them include drugs which are still prescribed for the same purposes. Most of these, however, are materials the action of which could scarcely be overlooked even by primitive man with sufficient natural curiosity to try eating them.

The publication of this leechbook *in extenso* is an important contribution to the scanty material available for the study of the medical ideas and practice of the Middle Ages. Its value is greatly enhanced by the interesting introduction provided by the editor, which reveals among other things how leechbooks of this kind were compiled and to what extent they owe their origin and their contents to Greek and Latin writers on medicine, who in their turn drew upon the Egyptians and to a less extent the Assyrians. T. A. H.

Animals and their Environment

(1) *Exploring the Animal World.* By Charles Elton. Pp. 119. (London: George Allen and Unwin, Ltd., 1933.) 3*s.* 6*d.* net.

(2) *The Ecology of Animals.* By Charles Elton. (Methuen's Monographs on Biological Subjects.) Pp. viii+97. (London: Methuen and Co., Ltd., 1933.) 3*s.* 6*d.* net.

"EXPLORING the Animal World", for the benefit of the listeners of the B.B.C. and to secure recruits, who will make organised observations, leads up to "The Ecology of Animals". Ecology obviously sets out to define the relations between animals and their surroundings. It requires a considerable knowledge of every section of zoology and, in most regions, of plant relationships as well. It is scarcely a subject that can be taught, but it is one suitable for team-work research in any region. Its technique consists of careful field observations and the accurate determination of the organisms, coupled ultimately with thought-out experimentation in the field and in the laboratory.

The author's articles, especially on the real life of animals, the significance of migration and the regulation of numbers, are highly esteemed, and now we are indebted to him for the first attempt to deal with the whole subject in book form, animal inter-relations, habitats and economic problems being also included. The ramifications of animal ecology may be illustrated by the consideration of the fishery research of the North Sea, almost every fact in relation to which is of importance to the question of fisheries, especially the inter-relationships of the animals and plants, both to one another and to the physical and chemical conditions. Other marine areas with their various environments are also being intensively studied, and we might, as examples, refer to plankton and coral reefs. Then we think of freshwaters and finally of the land. On the latter we judge that ecological studies have not advanced far, perhaps owing to the multiplicity of environments, the vast numbers of land animals and the power of flight, coupled with rapid reproduction, which causes large numbers of wanderers to visit places to which they scarcely belong.

The subject and the book are both important, but the author, in trying to give a balanced account of animal ecology in a space about fitted to one of his chapters, is bound to lay himself

open to misconceptions. In his statement that "the application of ecological ideas to these problems [of economic entomology] is as yet negligible"—two exceptions are mentioned—he is so challenging that we set out to discover what new ideas are now presented to us and what new "facts stand out clearly". Numbers are of prime importance, but here the ecologist works "within certain conventions" which are not explained, while the general omission of unicellular organisms, so essential in the food cycles of aquatic life, will assuredly invalidate many results. We learn of "the comparatively low number of species which make up any animal community of a major habitat such as a wood, a heath, a coral reef or a river", and that the most frequent values lie between 60 and 140. We turn to a table of examples "selected at random", and they do not carry conviction. Eighteen are aquatic where the omitted protistans are of major importance; of the land we have 4 arctic, 3 *Calluna* heath, bare sand and pine wood of Oxshott common, 3 very special, rotting and outgrowing fencing posts and dried fruits, and 5 animal communities in Canada and Great Britain. This seems to us scanty evidence for such a deduction and we wonder how to define "a major habitat". Surely the land plants give the essential basis for most animal communities and we would like to see how far studies of the plant and animal communities of rich areas, such as Wicken fen, bear out these numbers.

In the tropics we feel that a habitat consisting of a single species of plant would have to be chosen to give such small numbers, since the very uniform and distinctly unfavourable aspen land of Canada yields about 140 species. The reader must not be misled into thinking that much is established in animal ecology, any more than that mimicry is a "firmly established theory".

Short Reviews

La Turquie Agricole (*Partie Asiatique-Anatolie*) [in Russian, with a French summary]. Par Prof. P. Zhukovsky (P. Joukovsky). (Académie Lénine des Sciences agricoles de l'URSS: Institut de Production végétale.) Pp. xxvii + 908 + 12 plates. (Moscou et Léningrad: Les Éditions de l'Etat, Section Agricole "Selkhozghiz", 1933.) n.p.

THIS book is the outcome of three expeditions into Asiatic Turkey made by the author in 1925–27 on behalf of the Institute of Applied Botany at Leningrad. The practical aim of the expeditions was the discovery and collection of native varieties of cultivated plants suitable for introduction into Russia, and the bulk of the book is devoted to detailed monographic treatment, by some twenty authors, of the plants and their varieties cultivated in Turkey.

A large number of new varieties of wheat, rye, peas, lentils, melons, fruit-trees, etc., have been discovered and collected, and their characters studied by experimental planting in various districts of Russia. Many of them proved of exceptional value for immediate introduction, while others represent interesting material for hybridisation and selection. With regard to rye, the data obtained suggest that Anatolia was probably its original home, for it occurs there in great variety, both cultivated and wild, and its history can be followed. The cantaloupe melons, now widely cultivated under glass in Europe, were found in great variety in field culture in the Van vilayet.

Apart from the data on cultivated plants, which will be of the greatest value to plant-breeders, the book has a wider appeal, since the author treats his problem in a very broad-minded way and presents a thoroughly up-to-date survey of the geography, climatology, plant-geography and agriculture of Asiatic Turkey; no similarly comprehensive work on that country has appeared in any language since Tchihatcheff's classical monograph published seventy years ago and now completely out of print. The value of the book is enhanced by numerous illustrations (which, however, have suffered from the poor reproduction), sketch-maps of climatic and botanical regions, 27 pages of bibliography including a number of Turkish books, and statistical tables on Anatolian agriculture.

Tables of the Higher Mathematical Functions. Computed and compiled under the direction of Harold T. Davis. Vol. 1. (Published as a Contribution of the Waterman Institute for Scientific Research, Indiana University.) Pp. xiii + 377. (Bloomington, Ind.: The Principia Press, Inc.; London: Williams and Norgate, Ltd., 1933.) 25*s*. net.

THIS is the first volume of an undertaking which promises to be as imposing as it is important. The work, begun in 1927 under the direction of Mr. H. T. Davis with the assistance of twenty colleagues, aims at collecting and amplifying the tables of higher mathematical functions which are scattered through the literature of the subject, and thus rendering available a vast amount of useful material which is not always readily accessible.

The volume begins with a brief history and classification of tables and a chapter on certain mathematical processes. An account follows of

methods of interpolation by differences. Here the usual formulæ are given and illustrated, but no mention is made of the remainder terms. About forty pages of interpolation coefficients with a two-figure argument are included for use with the formulæ, and a bibliography in which attention is mainly paid to functions of the kind for which the work is intended. The tables in the present volume relate to the gamma and psi functions and comprise about 140 pages, at various intervals of the argument, and to 10 or more decimal places. This forms the most complete collection at present available of values of these functions.

These tables are to be welcomed on account of their fundamental importance in the numerical applications of difference equations. The type used is the flat variety and forward differences are printed on the same line as the tabular values. These are points which may not meet with universal approval. On the other hand, the printing is clear, and one should not grumble at an author who has produced such a useful set of tables.

L. M. M.-T.

An Introduction to Biochemistry. By Dr. W. R. Fearon. Pp. x+313. (London: William Heinemann (Medical Books), Ltd., 1934.) 10*s*. 6*d*. net.

THIS book is by the professor of biochemistry of Trinity College, Dublin, and is obviously intended primarily for medical students. One may be permitted to venture a doubt whether the average medical student, at any rate in Great Britain, is likely to wish, or be able, to probe quite so deeply into the intricacies of organic chemistry as he would be encouraged to do by a thorough study of Prof. Fearon's book, in spite of the fact that the author claims to have approached "the living organism . . . along the less worn path of *inorganic biochemistry*". However much this detailed approach may unsuit the book for the British medical student, it makes it all the more useful as a general reference book for medical practitioners and scientific workers. As such, it is thoroughly up to date, and apparently free from serious typographical or other errors, though the attribution to ergosterol of two different formulæ on two consecutive pages indicates somewhat hasty revision or proof reading.

The scope of the book is evident from the fact that it includes such diverse subjects as methods for identifying the common carbohydrates, the inter-relationship between the pituitary and the reproductive systems, food and vitamins, an introduction to glutathione, cytochrome and other oxidation catalysts, a rapid account of the chemistry and constitution of the sterols and bile acids, and so on.

In spite of the existence already of a number of excellent introductions to biochemistry, we see no reason why Prof. Fearon's book, with its somewhat novel method of approach and attack, should not find a useful rôle in the training of medical and other students.

A. L. B.

Minerals and the Microscope. By H. G. Smith. Third edition. Pp. xiii+124+13 plates. (London: Thomas Murby and Co.: New York: D. Van Nostrand Co., Inc., 1933.) 5*s*. net.

THE third edition of this well-known book has been partly rewritten but, in the general method of treatment of the subject, it preserves the characters which have commended it to students throughout the last twenty years.

In the first two sections, which deal with the optical properties of minerals and descriptions of rock-forming minerals, no essential changes have been introduced. The final part, which is concerned with the study of rocks, has, however, been entirely rewritten and brought up to date. The method of treatment is genetical rather than descriptive, and aims at supplementing the knowledge gained from the study of specimens and thin sections. Difficult subjects such as gravitative differentiation, liquid immiscibility and magmatic assimilation are discussed in simple language and with a minimum of highly technical terms.

Dr. Smith provides an excellent summary of the technique of sedimentary petrography in addition to a short general description of the principal sedimentary rock-types. About seven pages are devoted to the metamorphic rocks, which are also considered from the genetical point of view.

The simple presentation of the essential facts, and the abundant photomicrographs with which the descriptive portion of the book is illustrated, provide an excellent introduction to a difficult subject.

Name this Bird. By Eric Fitch Daglish. Pp. xiii+215+64 plates. (London and Toronto: J. M. Dent and Sons, Ltd.; New York: E. P. Dutton and Co., Inc., 1934.) 7*s*. 6*d*. net.

THE avowed purpose of this book is to provide a sure guide for those who can scarcely be said to have even a nodding acquaintance with the birds of the field and garden; enabling them to name any bird that they may see, or be so fortunate as to have in the hand. For their benefit a set of 'Keys' for identification has been prepared, but these are of little practical use. The confused arrangement of the species described in these pages will be apparent when it is pointed out that the coot, the starling, and the capercaillie are all bracketed together! These 'Keys' form Section I. In Section II the species follow one another in their natural order, and are briefly described. Unfortunately, however, nothing is said about the coloration of the *immature* bird, so that those who turn to these pages to enable them to identify, say, a young starling, or robin—to take but two examples—will turn in vain.

A number of coloured plates, and of crudely drawn figures, may help in the identification when the sexes are alike. The females differing from the males are not shown. But why are the knot, rednecked phalarope, and sanderling shown only in their winter dress, and the ruff and godwits only in their breeding-plumage?

Aberdeen Meeting of the British Association

THE full programme of the Aberdeen meeting of the British Association, to be held on September 5–12, should be now or shortly in the hands of members known to be attending. The programme itself forms only part of an unusually large bulk of literature issued in advance, for the local committee has prepared a handbook containing full details of all the local arrangements, descriptions of the general excursions, and so forth. Should any members find themselves apt to lose their way through all this mass of preliminary information, there is no need for them to do so, if by using the summary time-table of the meeting they are able to decide what they wish to do with the opportunities offered ; there are cross-references in the time-table to the appropriate pages in the handbook. The Scientific Survey of the city and district, also issued in advance, has expanded somewhat beyond the lines laid down in recent years, and may be thought to deal with one or two subjects outside the scientific scope ; but its interest never fails, and these surveys, in the course of years, ought to grow into an extraordinarily valuable series. They have certainly no equivalent in other readily accessible form.

Sir James Jeans announces the subject of his presidential address as the "New World-Picture of Modern Physics". The evening discourse which, as stated in the Preliminary Programme, is intended as a memorial lecture for the late president, Sir William Hardy, is now set out as a lecture on the "Storage and Transport of Food", by Sir Frank Smith ; and no subject, nor any lecturer, could be more appropriate to the dedication of the discourse. The other evening discourse will be given by Prof. W. L. Bragg on the "Exploration of the Mineral World by X-rays".

It is common knowledge that there has arisen a widespread demand, of recent years, that the Association should secure more effective communication between science and the public, on the general subject of the relations between science and the welfare of the community. On the side of science there is some measure of feeling (whether due to modesty, concentration, or aloofness) against any overt action in this matter on the part of the Association. This view, however, does not appear to be held by many, nor does it seem justified if the Association is to carry out the objects prescribed by its founders, one of which is to obtain more general attention for the objects of science. As for the public demand, there will not be at Aberdeen any set general discussion of this topic ; on the other hand, the public is offered a fuller opportunity than ever of appreciating specific applications of science to its welfare and interest.

It is too seldom recognised that the Association, as the principal mouthpiece between science and the public, always presents in its programmes a series of subjects of public interest : if the Aberdeen programme does not make this evident, none ever will. The title of Sir Frank Smith's discourse, already quoted, is a sufficiently good starting-point. Among the sectional presidents' addresses we find those of Prof. F. G. Baily on sources of cheap electric power ; Mr. H. T. Tizard on science at the universities—problems of the present and future ; Prof. H. M. Hallsworth on the future of rail transport ; Dr. Shepherd Dawson on psychology and social problems ; Prof. J. A. S. Watson on scientific progress and economic planning in relation to agriculture and rural life. Among the subjects of discussions or papers in the sections—taken almost at random—there are economic planning, town planning, water supply (a full discussion on underground water), the reduction of noise, the preservation of food, the chemistry of milk, nutrition in relation to disease, the application of soil and ecological studies to problems of land utilisation for forestry and grazing.

These may suffice for examples ; there are many others. If subjects of this sort are judged to need further investigation by means of committees, the Association has the mechanism to set such investigation on foot. In fact, action has been taken already in relation to some of the above. The recent inquiry by the Association into the desirability of a survey of inland water resources is well known ; the outcome (if any) of the representations made last month to the Government by the Association and the Institution of Civil Engineers is awaited with interest. What may have been almost forgotten is the work of the Association's committee, which from 1875 to 1895 sedulously collected data concerning underground water supplies, and, in the manner of that time, scattered its published results through the successive annual reports, in which they are interred. The committee's recommendations in 1895 were not dissimilar, so far as they went, from those which have been made now. The discussion on noise to be held at Aberdeen follows upon the previous ventilation of this subject in the engineering section : a practical outcome is promised in a demonstration, on behalf of the Association's committee on noise, of the successful modification of a motor bicycle's din. The subject of town and country planning is occupying the attention of more than one section and also of the delegates of the Corresponding Societies, which have lately been afforded, through the Association, an opportunity of indicating to planning authorities any scientific interests which may endorse arguments for the preservation of particular sites.

Aberdeen commands so wide an area of country necessarily so seldom accessible to the Association as such, that very full opportunities are offering for excursions and work in the field. The geological, geographical, botanical, agricultural and anthropological sections will be even more active

than usual outside their meeting-rooms, and the engineering section, among other visits, contemplates one after the meeting to the important hydro-electric works in the west of Scotland. It is not apparent from the programme that the zoological section is as yet concerning itself with the fauna of Loch Ness; but it will find special interests both in land excursions and in the fisheries. The important research institutions in the vicinity of Aberdeen will receive close attention from the sections interested (see NATURE, Aug. 18, p. 258). The general (as distinct from sectional) excursions (see NATURE, July 21, p. 110) are lavishly arranged, and it is hoped that as many members as possible will help the vigorous local organisation by indicating in advance, on the form provided, the excursions in which they wish to take part. The hospitality of the city and the university has proved itself already, and members will not fail to show their appreciation of it.

It is impossible here to enter into fuller details of the programme, but one point may be added. There is a tradition in the Association that Scottish meetings are always 'good' meetings. As a matter of fact the present writer, in a number of years' experience, has never been actively conscious of a 'bad' meeting, though there may have been degrees of goodness. But there is apt to be at Scottish meetings a certain special quality of enthusiasm, both among local scientific workers who take part in the arrangements and in the programme, and about the audience recruited from interested local residents. The article in last week's issue of NATURE affords sufficient evidence that the Aberdeen meeting will not fall short of this standard.

Morphology and Biochemistry

By Dr. Joseph Needham, Caius College, Cambridge

THOSE who are accustomed to ponder the ultimate problems of biology are aware that though the need for a comprehensive biological science is great, the difficulties in obtaining it are equally considerable. Such old antitheses as that of form and function need not, indeed, detain us, for as Woodger's analysis[1] made clear, form is simply a short temporal slice of a single spatiotemporal entity. The main difficulty which confronts the biologist concerns the fusion of the two great realms of morphology and biochemistry or biophysics. Because at the present day the biochemist has little enough to offer towards the solution of the problem of the maintenance of organic form, the morphologist is apt to suppose that no connexions exist, and to acquiesce in an acceptance of the ancient Aristotelian distinction between *materia* and *forma*. This, however, is a counsel of despair.

In much physiological thought of the past there was a tendency to forget altogether about the problem of organic form and to treat the reactions proceeding in the body as though they took place in some homogeneous medium. The rise of colloid science almost acted as a lightning conductor for these minds by allowing them to salute heterogeneity at one level while forgetting it at the higher ones. But the advance of biochemistry itself has demonstrated that organisation must be taken into account. The significant observation of Vlès and Gex[2] that the ultra-violet spectrometric curve of the intact echinoderm egg is not that characteristic of proteins though these substances make up by far the largest part of the solid present, and the equally significant finding of Pollack[3] that picric acid, a notable coagulating agent of proteins *in vitro*, produced no effect when micro-injected into the cell, pointed the way towards new conceptions. The work of Peters[4] on the effect of adsorption on the dissociation constants of fatty acids, and much other experimentation referred to in his Harben lectures[5] bore in the same direction; and recent investigations[6] of the cell-free extracts of muscle and yeast have indicated the formation of stabilisation products among the phosphoric esters which probably play little or no part in the normal processes of the living cell. Such facts as these do not throw doubt on the value of studying *in vitro* processes, they simply show the need for caution in their interpretation.

For the union of biophysics with morphology the situation is, however, not entirely hopeless. It must be always borne in mind that form persists down to the level of organic molecules, and is clearly possessed, for example, by 'crystals' of protein. The possibilities of studying the orientation of these have not so far been explored. The technique of X-ray analysis which has been so successful[7] in the case of hair and wool, and promises such interesting results with muscle, has not yet been applied to the proteins of the egg-cell. How illuminating might not such an analysis be, when applied to the cell-bridges which Moore[8] has shown to exist between the cells of the gastrulating echinoderm embryo, or to the primitive connective tissue fibres which are believed by Weiss[9] to guide the growth of cells later arising? Again, the possibility exists that the origin of dextrality and sinistrality exhibited by certain molluscan eggs in their cleavage[10] may be found in the stereochemical properties of the protein molecules composing them. Finally, we must probably assume that some oriented space-lattice of protein molecules is involved in the polarity which, as Conklin[11] and Wintrebert[12] describe, persists and determines cleavage after the movable ballast of the egg is shifted from place to place by centrifugation; and although as yet we know nothing of the way in which the primary organiser works in the amphibian egg, it is at least not

illicit to picture the orientation of protein chains by polar groups carried on a sterol-like structure[13, 14].

It is clear that the obscure relations between morphological form and chemical change are open to experimental attack at many points. But there are two prominent misconceptions existing at the present time as to how this should be done. On one hand there is a tendency to regard the problem as impossibly difficult and to postpone the consideration of it until the Greek kalends. On the other hand, there is a desire to replace the methods of experimental morphology by those of physiology in the hope of obtaining thereby a short cut into the arcana of biological organisation.

Those who support the first of these two outlooks maintain, in their favourite phrase, that organisation in biology must be regarded as axiomatic. "The biologist," says Gray[15], "must . . . accept the living state as he finds it" . . . "It seems . . . logical to accept the existence of matter in two states (the animate and the inanimate) as an initial assumption." Such a point of view appears to overlook the fact that by making biological organisation axiomatic, we correspondingly remove it from the realm of experiment. "As I understand it," he says[16], "the age-long discussion between the mechanist and vitalist schools of thought turns on how far we believe . . . that the facts of biology can be sorted out into a harmonious and satisfying series, without invoking conceptions which are found to be unnecessary in dealing with the facts of observation within the physical world." On the contrary, the inclusion of whatever special type of organisation may be found in living systems, within the sphere of science, has nothing whatever to do with vitalism, which posits some entity in addition to organising relations. The 'irreducibility' of biological categories can receive quite another interpretation, for the laws, for example, of the nematic or smectic state in liquid crystals are similarly irreducible to those holding good for common isotropic liquids. It is for us to investigate the nature of this biological organisation, not to abandon it to the metaphysicians because the rules of physics do not seem to apply to it.

The second misconception arises from an impatience with the thinking that has still to be done on the purely biological level, that is to say, among the 'complex components' of Wilhelm Roux. To suppose that this stage of thought can be avoided is a complete illusion ; it is essential to deal first with large packets of factors in a biological organism before proceeding to the finer analysis of smaller packets. Experimental embryology, as may be seen from the admirable recent book of Huxley and de Beer[17], has up to the present been mainly concerned with the influence of part on part in embryonic development. In this way, by observing the behaviour of parts in abnormal situations, the whole array of organiser phenomena was discovered, and a great deal more knowledge based on transplantations brought into being. Empirical discoveries on the purely biological level thus serve as stimuli to the physiologist to investigate processes which his methods alone would never have revealed in the first place. To characterise experimental embryology, therefore, as "one of the backward branches of biological science" (Wells[18]), is to reveal a complete failure to understand the process of biological discovery.

This failure probably originates from a confusion of thought on the part which mathematics should play in science. "Physiological analysis," says Wells[19], "depends very greatly, for its ideas and methods, on physics and chemistry, and in these sciences the emphasis has lain on quantities rather than on shapes." Is not this a false antithesis ? Both shape and quantity must surely be regarded as ultimately definable in terms of numbers. A topological system or a figure in solid geometry is surely as numerical in its way as a finite number of quantitative weight-units. We are not indeed as yet equipped with the mathematical armamentarium which morphology requires, but this should not be allowed to obscure for us the fact that the central problem of biology is the form-problem. After all, it is essential to realise that although the quantitative in the restricted sense of chemistry has a great part to play in biology, nevertheless arithmetic does not exhaust the realm of logical order, nor is it the only form which scientific exactness may take. There are other systems of structure besides arithmetic, and the complex components may be very faithfully dealt with on their own level. An outstanding example of this is the accuracy of prediction attainable in genetics. They must, in fact, be ordered in this way before they can be linked with physico-chemical knowledge.

We may say, then, that to discuss biology with exclusive attention to matter at the expense of form is, to use the ancient phrase, "Hamlet without the Prince of Denmark". On the other hand, to discuss it with biological organisation regarded as something fundamentally inscrutable, is at least equally futile.

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[19] loc. cit.

Ancient Indian Iron*

By S. C. BRITTON, Salters Fellow, University Metallurgical Laboratories, Cambridge

METHOD OF PRODUCTION

THE careful investigation of I. E. Lester[16] and of A. K. Coomaraswamy[17] indicate that iron was produced in ancient India by direct reduction from the ore, and that the process was precisely similar to that employed by primitive Indian craftsmen down to comparatively recent times. The description given by Prof. Henry Louis[18] of the process which he witnessed at Jubbulpoor may be quoted to give an idea of the method of working:

"The furnace was built of dried clay along the edge of a trench some 3 feet high above the trench; the bottom of the hearth was about a foot above the bottom of the trench so that the furnace was about 5 feet high inside; it was about 10 inches square at the mouth, but widened out to about double that size at the hearth. The back and side walls were about 2 feet thick, but the front wall, facing the trench, was only a couple of inches in thickness. Through that passed a couple of tuyères, made of dried clay, about 2 feet long, pierced with a 2 inch hole. The blast was supplied by means of a pair of circular goat-skin bellows worked by hand; a roof of branches and leaves was built over the bellows to screen them (and the man blowing them) from sparks. The furnace was filled with charcoal, and, after that had been ignited, small baskets of ore and charcoal were thrown on alternately at intervals of about half an hour. After some ten or twelve hours' work, the thin wall was broken down, and a bloom of some 70 lbs. weight was got out. That rough bloom was cut into pieces, heated up in a primitive forge and hammered into flat cakes, in which form it was sold."

Lester[16] is strongly of the opinion that the quality of Indian iron is due to the cunning of the smith in making a selection from the metal produced from the ore and to his operative skill.

There seems little doubt that the ore used was generally the nodular hæmatite which is fairly widely distributed in India. A typical analysis given by Hadfield[19] is SiO_2, 9·14; Al_2O_3, 9·85; Fe_2O_3, 72·39; FeO, 0·22; moisture, 8·40; S, nil; P_2O_5, 0·05.

The extremely low sulphur content of all the ancient specimens analysed shows that a pure charcoal was generally used for smelting and treating the metal.

RESISTANCE TO CORROSION OF ANCIENT INDIAN IRON

Pliny, the Roman historian[20], stated that there was in existence at the city of Zengma, upon the Euphrates, an iron chain by means of which Alexander the Great constructed a bridge across the river; the links of the chain which had been replaced had been attacked by rust, while the original links were quite exempt from it. This belief that the iron of to-day is inferior to that of yesterday has echoed down the ages, and most observers have been content to repeat it to explain the state of preservation of ancient Indian iron. Several suggestions have been made as to the direction in which the alleged superiority lies. Hadfield, dealing with the Delhi pillar, regards the purity of the metal and absence of inclusions as responsible for its preservation. Protagonists of copper steels have alleged that a small percentage of copper might be responsible. A. S. Cushman, discussing Hadfield's work on Sinhalese iron[21], reported that old wrought iron nails which had shown almost perfect resistance to corrosion for a hundred years in Virginia, had a very similar composition to the Sinhalese specimen, having an analysis C, 0·03; Mn, 0·06; P, 0·205; Si, 0·121; Cu, 0·027. He doubted whether the resistance of ancient steels was due to the presence of copper in them; the three Sinhalese specimens examined by Hadfield showed percentages 0·012, 0·090 and 0·119, but all were corroded in similar fashion. Perhaps the combination of low sulphur and low manganese with high phosphorus produced corrosion resistance.

*(Continued from p. 240.)

Wallace reported[22] the general freedom of Indian iron from rust and mentions that he has noticed that modern native-made iron forged on a stone anvil does not rust like English iron. "The iron-work of the car on which the Gods of the Kulu valley take the air has a fine brown patina and no rust flakes. It is all charcoal iron." Discussing this communication, Carulla suggested that forging on a stone anvil might "Siliconide the skin of the iron" and thereby make it resistant.

Rosenhain[23] suggested that much ancient iron contained a large amount of cinders in layers so that corrosion proceeded until a cinder layer was reached and then ceased. Also Desch[24] noted that many specimens looked as if coated with a fine adherent layer of slag. However, Hadfield has been unable to find any evidence of such coatings on the materials which he has examined.

Several observers have been inclined to believe that there is not inherent superiority in the metal over modern products. Graves, discussing the paper of Friend and Thornycroft[25], commented that, of the many specimens of ancient iron which he had seen in India, some were rusted and some were not, the difference apparently depending on the situation. In the same discussion Prof. Louis suggested that the preservative factor was essentially climatic.

Friend[26], discussing the Delhi pillar, states that the composition of the metal "tends toward the reduction of corrodibility but does not suffice to explain the general immunity of the pillar from corrosion. This suggests that the resistance to

corrosion is due to the surface condition of the metal, which in other similar cases is usually known to be highly polished". He goes on to mention "the ancient custom of anointing the pillar with butter at certain religious festivals" as a contributory cause of a resistant surface.

There appears to be some confusion amongst the various views expressed as to whether the various well-preserved specimens have suffered corrosion at a remarkably slow rate or have suffered no corrosion at all, and it seems worth while to consider what could be the reason of either alternative. If there has been no corrosion, three possible explanations arise: that the metal is by reason of its composition not susceptible to attack, that it is covered by an oxide scale, formed in manufacture and never broken, or that the rain falling or moisture condensing on the metal is alkaline.

It seems unlikely that the original scale should never have been broken, especially, for example, on the fractured surfaces of the Dhar pillar.

R. B. Mears has recently, at Cambridge, used the method[27] developed by himself and Dr. U. R. Evans to compare the susceptibility to attack of modern iron and steels with that of a specimen of the Dhar pillar, the gift of Sir Edwin Lutyens to Prof. A. Smithells, who kindly allowed its use for the experiment. The specimens used were all ground, the final grinding being carried out in identical fashion for all materials. The method of the experiment consists essentially in the determination of the proportion of drops of distilled water (condensed in quartz) which cause rusting of the material in 24 hours under an atmosphere having pure oxygen and pure nitrogen in equal parts. The figures obtained were:

Pure Carbonyl Iron	0 per cent
Electrolytic Iron	8·3 ,, ,,
Modern Wrought Iron	82·8 ,, ,,
Modern Mild Steel	87·9 ,, ,,
Dhar Pillar Iron	100·0 ,, ,,

Although the various materials used may not be typical of their classes, and the Indian specimen may not be from the best part of the pillar, the numbers do show that the ancient iron cannot well be less susceptible to the commencement of corrosion than the modern products. The fact that corrosion began so readily under 'pure' conditions suggests that the Indian pillars have been corroded to some extent, unless the rain which falls on them is alkaline.

The results obtained in recent work show fairly definitely that the idea that special resistance to atmospheric corrosion can be conferred on iron or steel by eliminating minor constituents (particularly carbon and manganese) is wrong, though there is considerable evidence to show that physical unsoundness or the presence of sulphide inclusions causes premature failure.

In American tests[28] forms of iron low in carbon and manganese faired somewhat badly as compared with the steels. U. R. Evans and the author[29] compared the resistance of a pure electrolytic iron having C, 0·03; S, 0·005; Mn 0·04; P, 0·02; with that of a steel having C, 0·026; Si, 0·14; Mn, 0·57; P, 0·018; to corrosion in the atmosphere of Cambridge. Purity (that is, the absence of a second phase) and surface 'smoothness' undoubtedly retarded the early development of rust, but after six months, any difference which existed between pure iron and good mild steel in the unpainted condition was in favour of the steel.

It has to be remembered that the Indian irons are really wrought irons, and there is some evidence to show that under modern English conditions, wrought irons can give superior service to steel. For example, many structures, such as the High Level Bridge at Newcastle, erected in 1845, the Conway Tubular Bridge, erected in 1846, and the Menai Tubular Bridge, erected in 1852, are still in service, though it is possible that their preservation is the result of effective painting.

The exposure tests of Evans and the author[30] at Cambridge "point to the good behaviour of wrought iron. This is apparently due to the infrequency of specially susceptible points, the greater tendency to passivity and the convenient character of the scale". However, it remains true that in the English or American climates the rates of corrosion of wrought iron, good steel and 'pure iron' are substantially of the same order of magnitude, and it is safe to conclude that a slow rate of attack of such objects as the Delhi pillar is not due to their composition alone. It seems probable that climatic conditions have been the preservative factor.

For centuries after the erection of the Delhi pillar, the atmosphere of its neighbourhood must have been substantially free from pollution by any products of combustion, and its distance from the sea rendered the presence of much salt in the air unlikely. The dryness of the climate was sufficient to ensure that the pillar was only wet during the fall of rain, which must have been effectively distilled water. In these circumstances the initial rate of corrosion of the pillar would be extremely slow. W. H. J. Vernon[31] showed that an initial period of exposure of iron to a relatively non-corrosive atmosphere greatly reduced the rate at which it was corroded when the conditions were made more severe; the Indian columns may have benefited by this effect in being erected initially during the 'dry' season.

The extremely slow attack may well have built up a very closely adherent and complete layer of rust which, being free from hygroscopic salts and in a hot climate did not, as rust often does, promote attack by keeping the metal moist, but actually served to shield the metal and reduced still further the rate of attack. It may be supposed that the rust layer became in the course of centuries sufficiently protective to withstand the arrival of a more polluted atmosphere. The bronze-like patina described so often may well be due to this compact layer of ferric hydroxide.

It is worth noting that in parts of India to-day, modern steels are giving excellent service. Indian

railway authorities state, for example[32], "The conditions on the Railway are tropical and there is very little corrosion. Steel trough sleepers removed from the main line after 35 years service still retain a great deal of the original mill-scale" and "Iron covered goods wagons built in 1883 are still free from corrosion" but "Plates which give over thirty years of life in this part of India do not last more than a few years in Burma or on the Bombay Coast".

Thus, the most probable explanation of the preservation of the Delhi pillar seems to be the combination of 'purity' of atmosphere and the climate. The other specimens of Indian iron have not all had the same favourable conditions although the metal is similar and so a good deal of rust is found on some of them. The specimens of ancient iron found in countries other than India may be said in general to be in a state of preservation varying with their climatic environment. Thus many specimens, preserved excellently, have been excavated in Egypt[33]; here conditions have been dry, stretches of the desert are alkaline, and the atmosphere is unpolluted, though it has also been suggested[34] that the iron is of meteoric origin and owes something of its preservation to a high nickel content. On the other hand, specimens of Roman iron found in Britain are found to be extremely rusty, although Friend and Thornycroft[35] comparing the still metallic part of a corroded nail with a modern mild steel found that the ancient iron was the more resistant to corrosion of the two.

On the whole, it must be concluded that, although we should regard the operative skill and capacity for hard work of the ancient smiths with admiration, we cannot really expect to solve our corrosion problems by contemplation of their products.

[16] Presidential Address to the Staffs. Iron and Steel Inst., Sept. 30, 1911.
[17] "Medieval Sinhalese Art".
[18] *J. Iron and Steel Inst.*, No. 1, 129; 1912.
[19] *J.I.S.I.*, No. 1, 152; 1912.
[20] Pliny, Book XXXIV. Chap. 43.
[21] *J.I.S.I.*, No. 1, 179; 1912.
[22] *J.I.S.I.*, No. 1, 84; 1908.
[23] *Trans. Far. Soc.*, 11, 236; 1916.
[24] *J. West of Scotland I.S.I.*, 1913–14.
[25] *J.I.S.I.*, 122, 237; 1925.
[26] "Iron in Antiquity", p. 147.
[27] *Proc. Roy. Soc.*, 1934.
[28] Report of Com. A 5, *Proc. Am. Soc. Test. Mat.*, **27**, Part 1; 1928.
[29] *J. Soc. Chem. Ind.*, **49**, 173, T; 1930.
[30] *Trans. Electrochem. Soc.*, **64**, 48; 1933.
[31] *T.F.S.*, **23**, 164; 1927.
[32] "Corrosion Committee of Iron and Steel Inst. First Report (1931)", p. 18.
[33] Hadfield, *T.F.S.*, 11, 183; 1916.
[34] T. A. Rickards, *J.I.S.I.*, No. II, 333; 1929.
[35] *J.I.S.I.*, 11, 225; 1925.

Obituary

M. B. Baillaud

BENJAMIN BAILLAUD was born in 1848, a year of revolutions, and his peaceful life, which came to an end on July 8 last, was crossed by two wars which shook France to her foundations. Passing through the École Normale, he became an assistant to Leverrier at the Observatory of Paris, and also his substitute at the Sorbonne. After the defeat of France in 1870, Baillaud, then at the meridian of his energy and clearness, shared in the immense revival of France which had its place in the sciences, as well as in other directions. Sent to Toulouse, to reform the Observatory in succession to Tisserand, and afterwards as dean of the Faculty of Sciences, he performed these duties with singular zeal and effectiveness. He modernised the Observatory and brought many men, since famous, to the University; in the former respect we may mention only, as an instance of his foresight, that he developed as a pioneer, celestial photography. He also established at the greatest height then known, more than 9,500 ft., an observatory, chiefly, of course, meteorological, on the Pic du Midi de Bigorre, in the Pyrenees.

Chosen director of the Observatory of Paris in 1907, and so titular head of French astronomers, Baillaud added to his previous work on celestial photography an interest especially in time determination and distribution, a matter in which his friendship with Ferrié, then in charge of the station at the Eiffel Tower, assisted. The Observatory of Paris has a long and notable history, and is housed in Paris in a celebrated building, which is scheduled among the historic monuments of France. It was in Baillaud's time, however, somewhat out of date in equipment. He had, fully formed, complete plans for the renovation of the observatory, but circumstances prevented a repetition of his work in re-equipment, as at Toulouse, as it also prevented his repeatedly expressed desire for retirement.

The latter was not the desire of the astronomers however. When the sixth Congress met in 1909 to regulate celestial photography and produce the astrographic catalogue and the Carte du Ciel, Baillaud was chosen president. Later, with Ferrié, two successive congresses were summoned at the instance of the Bureau des Longitudes, in 1912 and 1913, to deal with time distribution, which was initiated, so far as Europe was concerned, and has since been maintained, from the Eiffel Tower, and afterwards from other more powerful stations; the first of these congresses chose Baillaud as its president, and he kept the organisation in being right through the War, though none of the countries which had initialled the document creating the Bureau de l'Heure ratified it. He only resigned this charge, as he resigned that of the Carte du Ciel—without ceasing an interest in them—in 1919, when he was chosen as the first president of the International Astronomical Union;

which with his invariable sense of duty he demitted in 1922; but he did not cease to attend the meetings. He was present at Cambridge in 1925, when the University conferred an honorary degree upon him.

Baillaud's work was for the most part administrative and official, so there is comparatively little to signalise personally, and that is technical; but he was a good mathematician, and contributed many discussions upon the usual subjects. He retired in 1926, and lived until the present year in the south of France, chiefly about Toulouse, or the Pyrenees, to which he was much attached.

He was a man of many friends, and incapable of rancour. In his long retirement he became, as a relative writes, *toute bonté*. R. A. S.

WE regret to announce the following deaths:

Prof. B. J. Collingwood, O.B.E., professor of physiology in the University of London, on August 9.

Prof. G. Dreyer, C.B.E., F.R.S., professor of pathology in the University of Oxford, on August 17, aged sixty-one years.

Prof. W. M. Hicks, F.R.S., formerly professor of physics and also first Vice-Chancellor of the University of Sheffield, on August 17, aged eighty-three years.

Prof. W. McF. Orr, F.R.S., lately professor of pure and applied mathematics at University College, Dublin, on August 14.

News and Views

Sir Peter Chalmers Mitchell, C.B.E., F.R.S.

AT the August general meeting of the Zoological Society of London, it was announced that Sir Peter Chalmers Mitchell would retire from the secretaryship at the annual meeting next April, and the Council would nominate Prof. Julian S. Huxley for election as his successor. For the past thirty years, Sir Peter has done so much towards making the Zoological Gardens more attractive to the public, while adding to the opportunities which they afford for scientific research, that his retirement marks the end of a brilliant epoch in the history of the Society. Only those who have been closely associated with him can realise the indebtedness of the Council to his ever-ready initiative and inspiration in the undertakings which they have entrusted to his tactful direction. One of his earliest tasks was the removal of the offices, library, and meeting room from Hanover Square to a new building in the Gardens, where there was more ample and convenient accommodation. A small extension to the Gardens was then arranged, in return for the provision of some paddocks open to public view in Regent's Park. The Mappin Terraces soon followed as a generous gift, and eventually the Society was induced to risk great expenditure in placing under the Terraces the Aquarium, which was so well planned and arranged that public appreciation returned the outlay almost at once. The new buildings for apes and monkeys, reptiles, and insects, besides rearrangements for the parrots and smaller birds, and the provision of an adequate sanatorium, should also be mentioned; nor must the new and comparatively luxurious refreshment houses be forgotten. Sir Peter Chalmers Mitchell, however, will always be best remembered by the great share he took in the acquisition, planning, and organising of the Zoological Society's country park at Whipsnade, where wild animals live under almost natural conditions, and can be studied in ways for which there is no provision in an ordinary menagerie.

THROUGHOUT his administration, Sir Peter Chalmers Mitchell has always encouraged the use of the Society's collection for scientific research. His own work on the anatomy of vertebrates came nearly to an end with his great memoir on the intestinal tract in mammals in the Society's *Transactions* in 1905, but he continued to stimulate others in the prosectorium, and he organised new lines of investigation. He induced a succession of pathologists to join the staff, and they have now for many years published valuable results, besides helping to improve the health of the animals. Parasites have been systematically collected and studied; and for some time after its foundation the scientific problems of the Aquarium were examined by a special assistant. The scientific meetings of the Society have been arranged to make a wider appeal to the fellows, and most of the technical papers are now taken as read for publication in the *Proceedings*. Sir Peter, indeed, will hand on to his successor an admirable organisation for making the best use of the scientific resources of the Society. He retires with the best wishes of zoologists for the enjoyment of his well-earned leisure, which will enable him to return to the quiet contemplation of the subjects which he has made his own.

Centenary of Sprengel, 1834–1906

AMONG the many men of science of German birth who during last century made England their home was Herman Johann Philipp Sprengel, F.R.S., the centenary of whose birth occurs on August 29. Born at Schillerslage near Hanover, he studied physics and chemistry at Göttingen and Heidelberg, taking the degree of Ph.D. in 1858. In January 1859 he came to England and for three years was associated with Brodie at Oxford. He then settled in London and engaged in research work at the Royal College of Chemistry and in the laboratories at Guy's and St. Bartholomew's Hospitals. From 1865 until 1870 he was chemist at Farmer's chemical works in Kennington, after which he devoted himself mainly to his own inventions. He was elected F.R.S. in 1878 and in 1903 the title of professor was bestowed upon him by the German Emperor. He died suddenly on January 14, 1906. Sprengel will always be remembered for his invention in 1865 of the dynamic

mercury pump which made possible the evacuation of Swan's and Edison's electric glow lamps, Crookes's radiometer and Röntgen's apparatus, and for his improvements in explosives. In 1871 he took out patents for a class of explosives which were non-explosive during manufacture, storage and transport, but for want of encouragement he allowed the patents to lapse. His explosive 'rack-a-rock' was used in 1885 for removing the Flood Rock Reef which obstructed the entrance to New York Harbour at Hell Gate, some 300,000 lb. of the explosive being used. He also devised a U-tube for the determination of the density of liquids, introduced the use of a finely divided spray of water in the place of steam in sulphuric acid chambers and was the first to direct attention to the value of picric acid as an explosive.

New Belgian Ascent into the Stratosphere

DR. MAX COSYNS is to be warmly congratulated on his successful ascent into the stratosphere on August 18. The disaster of the two previous ascents had not deterred the chief actors in this from going forward with their preparations, for it will be remembered that the American ascent came to grief only so recently as July 28. Dr. Cosyns was accompanied on this ascent by M. van der Elst, and the project was under the auspices of the Belgian Fonds National de la Recherche Scientifique which gave the balloon its name *F.N.R.S.* It had a capacity of about 14,000 cu. metres and was provided with an aluminium gondola with special means of rapid exit. The motive of the flight was the investigation of the directive tendency of the cosmic radiation, and as a good landing has been made it is to be hoped that the records are safe. The ascent was made from Hour-Havenne in the valley of the Lesse in Belgian Luxembourg at 6.10 a.m. on Saturday in perfect weather conditions, and the descent at Zenavlje in Yugoslavia at 9.30 p.m. on the same day. The height reached, as reported in the daily newspapers, was about 10 miles. Though this does not constitute a record for height, the recent aeroplane work of Blackett and Gilbert in Great Britain at comparatively low altitudes shows the value of such data as may be obtained in this manner in resolving the problem of the directive tendency of the cosmic radiation. A further point of interest is the fact that the balloon covered a distance of about 1,000 miles in a general south-easterly direction during a period of 15 hours. This would indicate a very high wind velocity at high altitudes.

Cambridge Lake Rudolf Rift Valley Expedition

THIS expedition has now been in the field some eight months, and we regret to report that on August 14 two members—Dr. W. S. Dyson, naturalist, and Mr. W. H. D. Martin, surveyor—are reported missing on South Island. There are three uninhabited volcanic islands in the lake: Central Island, studied by the Cambridge Expedition of 1930–31, North Island, visited in 1932 and South (Höhnel) Island, which has remained unknown since it was roughly mapped from the mainland during the original exploratory journey by Teleki and von Höhnel in 1885. Its study was a particular object of this year's expedition, which has a folding boat and outboard motor for the purpose. The two men crossed the five miles of open water to the island about August 1, and after a fortnight in which prearranged signals were not received on the mainland, Mr. V. E. Fuchs, leader of the expedition, asked for Government assistance, if possible by aeroplane, to aid in the search. If the missing men are on the island they should have little difficulty in obtaining subsistence on fish; the water is potable though unpleasantly alkaline. Earlier in the year the expedition, which is mainly geological, proceeded up the west side of the lake with the view of going to the Omo River and excavating important bone beds *en route*. The Malembe triangle, where Kenya borders on the Sudan and Abyssinia, is somewhat unsettled and an armed guard had to be taken north from Lokitaung; this impeded the work, but valuable collections and surveys have been made. After returning south, the expedition moved to the south-east corner of the lake to study the eastern scarp of the rift valley, where high-level beaches were reported by the 1931 expedition. It was here that the unfortunate incident occurred.

Gift to the University of Birmingham

AT the meeting of the Court of Governors of the University of Birmingham in February, reference was made to the urgent need of further accommodation for the Department of Chemistry, but it was pointed out that the financial commitments incurred in the building of the new Medical School were such as to make the desired addition to the chemistry building impossible for the present. The difficulty has now been solved by the generous gift of £45,000 by Mr. A. E. Hills, a Birmingham tube manufacturer, for the specific purpose of erecting an additional block of buildings for the Department of Chemistry. In his letter to the Pro-Chancellor, Mr. Hills says: "For some time past I have had in my mind the desire to assist the higher education of those likely to be engaged in industry in Birmingham and the Midlands, with which I have been closely connected in my business life. I have come to the conclusion that I can best do so by helping the University in one of its scientific departments which is in need of extension. . . . It seems to me that the department most overcrowded and badly housed is that of Chemistry. Much of its work is being carried on in wooden huts which are inadequate and are becoming dangerous. The present Chemistry block is insufficient for the increasing number of students who come to it for the training in chemistry which forms a necessary part in practically all scientific careers, and also for those engaged in post-graduate research." It is understood that the new block will fill the gap between the existing chemistry and geological blocks, thus completing the western part of the architect's original scheme for the group of buildings.

Edinburgh Geological Society

BY the end of this year, the Edinburgh Geological Society will have been in existence for one hundred

years. In order to take advantage of the presence in Scotland of many foreign and overseas geologists who will be attending the Aberdeen meeting of the British Association, it has been decided to hold the centenary celebrations early in September. Invitations have been sent to learned societies at home and abroad, and a large number of delegates will take part with the fellows of the Society in various functions. On Monday, September 3, the delegates from kindred societies will be received in the buildings of the University of Edinburgh, where they will be welcomed by the president, Sir John Flett, in the name of the Society, and by Sir Thomas Holland, in the name of the University. During the afternoon, visits will be paid to the Royal Scottish Museum and the offices of the Scottish branch of H.M. Geological Survey. In the evening, the Society and its visitors will be the guests of the Lord Provost and Town Council of Edinburgh at a reception in the College of Art. Tuesday morning will be devoted to hearing short addresses by eminent geologists in the new Geological Department of the University. The party after lunch will make a tour of various places of geological interest in and around Edinburgh. A dinner on Tuesday evening given by the Society to the visiting representatives will bring the functions to a close.

Earthquake in Scotland

AN earthquake of unusual strength occurred in Ross-shire and the surrounding counties on August 16 at about 2.15 a.m. (G.M.T.). The early accounts are insufficient to determine its intensity and disturbed area, but it seems to have reached the degree 7 (Rossi-Forel scale) and to have been felt over at least 10,000 sq. miles, for it was observed at such places as Glenshiel in west Ross-shire and Pitlochry in Perthshire. Its strength is also evident from the fact that it was recorded at West Bromwich, where, at about 2.25 a.m., it caused the pointer of the seismograph to move an eighth of an inch. The principal earthquake zone in the north of Scotland is the portion of the Great Glen fault that lies between Inverness and Loch Ness. As most of the places from which reports come cluster in the neighbourhood of Dingwall, it is possible that the origin may lie in that district.

Element 93: A Correction

X-RAY spectroscopic analysis has failed to confirm the presence of any new element in pitchblende from Joachimsthal. Dr. O. Koblic has consequently withdrawn his claim to the discovery of an element of atomic number 93 in this uranium ore, concerning which an announcement was made in NATURE of July 14, p. 55. He now states that the substances he supposed to be the silver and thallium salts of an acid, $H(93)O_4$, were sent to Prof. V. Dolejšek (Prague) and to Drs. I. and W. Noddack (Berlin) for X-ray spectrum examination. No lines corresponding to an element of atomic number were obtained but the presence of tungsten was unmistakable. Tungsten was also detected afterwards by chemical means in Dr. Koblic's preparations. The erroneous atomic weight determination arose from the assumption that his silver salt was $Ag(93)O_4$ whereas it was actually silver tungstate. The unusual behaviour of tungstates in acid media is suggested as an explanation of the reactions described by Dr. Koblic (*Chemický Obzor*, 9, 129; 1934) which he attributed to the presence of a new element. This withdrawal has, of course, no reference to the earlier work of Prof. E. Fermi dealing with the 'synthesis' of an element of higher atomic number than uranium (NATURE, June 16, p. 898).

An International Air Police Force

LORD DAVIES continues his vigorous campaign for an international police force in a new booklet entitled "Force and the Future" which deserves notice as a shorter and more incisive statement of the argument of his larger work, which we have already noticed in review. He also brings it up to date by arraigning the Government on several counts for holding up the League of Nations and failing to provide it with the means of enforcing its will. The discussion of these is clearly out of place in these columns, but it is germane to science to point out that, as time goes on, opinion seems definitely to be settling on the air as the sphere of action in which international co-operation is most appropriate, feasible and urgent. A well-thought-out plan for a European air police has lately been submitted to the League of Nations Union by Rear-Adm. R. N. Lawson and should be carefully considered by the government experts and everyone who is anxious to move in the direction of greater security and union among the nations. If not immediately practicable in the form of police, it clearly is so in the form of greater facility and safety in transport and communication. Started in this way, as the International Postal Union was in the middle of last century, a union or bureau associated with the League of Nations would secure a much more efficient and economical way of utilising the air for peaceful purposes, and indirectly sidetrack the horrors of bombing from the air which Lord Davies and many others have held up to us as the inevitable result of man's latest conquest. Were the air used habitually for its obvious purpose of bringing the nations easily together, it would soon seem as mad and monstrous to use it for destruction as for the barber to cut your throat when you sit down to be shaved. While man has free will, one cannot absolutely rule out the possibility of the wildest actions, but one can make them, by controlling habits, improbable to the highest degree.

Community Education and Training

IN a paper on "The United States United Communities Bill from the Point of View of India's Educational Problems" read before the ninth All India Educational Conference in December, 1933, Capt. J. W. Petavel, formerly lecturer on the poverty problem in the University of Calcutta, explains that the United Communities Bill aims at providing for

the financing by the State of a system of modernised mutually co-operating co-operative colonies. In other words, it plans to bring into existence an organisation of people who would be customers to one another, and thereby independent of fluctuations in general trade prosperity. Capt. Petavel claims that co-operative colonies for education would be the easiest type to establish, and that in India they would enable an ideal educational programme to be planned. They would revive in a modern form the old Indian *Gurukul* education system as was strenuously advocated by the late Sir Asutosh Mookerjee. In the educational colonies, three hours per day might be devoted to productive work of a suitable kind, which it is claimed is the first item in any ideal educational programme. Another three hours devoted to organised games would serve to develop muscle, alertness and disciplined co-operation. In the ideal programme there would be time also for instruction conveyed by drama, song and similar methods. Class-work need then occupy not more than four hours, leaving fourteen hours for rest and recreation. The colonies would be practically self-supporting, since the pupils would cultivate the land that would give them and those who taught them their food. In the Indian rural districts, the educational 'united communities' would be centres also of technical training of all kinds. They would be the seed farms, stock farms, demonstration farms and centres of rural reconstruction generally.

The Ministry of Health in 1933-34

THE fifteenth Annual Report of the Ministry of Health was issued on August 11 (Cmd. 4664. London: H.M. Stationery Office. 6*s*. net). The Report, which relates to the year ended March 31, 1934, is divided into six parts—public health, housing and town planning, local government and local finance, administration of the poor law, national health insurance and contributory pensions, and the Welsh Board of Health. As in previous years, the Annual Report of the Chief Medical Officer of the Ministry is published separately. During the twelve months, private enterprise built without subsidy 207,869 houses, which constitutes a record. The opportunity has been taken to include in the Report a full review of the public health services under the conditions created by the Local Government Act, 1929. The number of samples of food analysed by public analysts during the year 1933 was 138,171, of which 7,601 samples were reported as adulterated or not up to standard, a percentage of 5·5, being a slight increase over the two previous years. As regards infectious diseases, the notable features of the year were an increase in the prevalence of scarlet fever, concurrently with an increase in the prevalence in diphtheria, an increase in the prevalence of and mortality from cerebro-spinal fever, and a decline in the incidence of smallpox.

The Giorgi System of Units

AN interesting note on the metre, kilogram, second and 'another unit' system of units by Prof. G. Giorgi has been published by the International Electrotechnical Commission (I.E.C.) the central office of which is at 28, Victoria Street, S.W.1. This system of units has already been described in NATURE of April 21, p. 597. The committee for electric and magnetic units voted last year unanimously in favour of a proposal to arrange the system of practical electrotechnic units into a complete absolute system usually called the M.K.S. system. In this paper, Giorgi describes the three well-known groups of units, the C.G.S. electrostatic, the C.G.S. electromagnetic and the group of practical units. He commends the national system of units devised by Heaviside, in which the 4π is displaced and a perfect duality between electric and magnetic formulæ is secured. The theory of physical dimensions is better understood than it was fifty years ago. No one now believes that everything in the physical world depends necessarily on three fundamental quantities, length, mass and time. Giorgi shows that by taking the ampere, or the volt, or the coulomb as the fourth unit, he can build up a complete absolute system from four fundamental units. This set of units is neither electrostatic nor electromagnetic; it is in agreement with the principle of duality and can be used with either rational or non-rational derived units. All units of the system lie between the smallest and largest magnitudes that present science has to measure. It will simplify the learning of the theory of electricity by students of electrical engineering. No proposal is made to discard the existing systems of units. Each one will be employed according to the requirements of the subject and the preference of the user. Future practice will show which is the most convenient.

Before Papyrus: Beyond Rayon

AN interesting and brightly written paper by Dr. G. J. Esselen, the president of Inc. Chemical and Research Development of Boston, is published in the *Journal of the Franklin Institute* of March. It is entitled "Before Papyrus . . . Beyond Rayon". Rayon a few years ago was universally known as artificial silk. The basic chemical substance to which the writer refers is cellulose. It forms the structural framework of all vegetable life and is the raw material of great industries. The reason why the derivatives of cellulose were so slow in developing is that it is only a few years ago since its empirical composition was discovered. Transparent sheets of cellulose plastic are used in the manufacture of the laminated 'glass' used in automobiles. A recent discovery has so lowered the cost of the manufacture of cellulose acetate plastic that at the present time more than 70 per cent of all the laminated 'glass' manufactured in the United States is made from it. They also make bullet-proof 'glass' composed of five laminations, the centre one being a piece of plate glass about $\frac{3}{4}$ in. in thickness. It is being used for the windows of armoured cars and cashiers' cages in banks. In 1910, no rayon was being made in the United States. In 1931, 144 million pounds were produced. Methods of manufacturing rayon are continually improving, greatly increasing its strength and its resistance to

water. A new use of cellulose is the manufacture of shoes. With this material all sewing and nailing of the soles to the uppers are eliminated. The cement used to stick them together is a cellulose nitrate cement. It is now only necessary to hold them together for fifty seconds. A single operator in 8 hours 15 minutes applied soles to 1,580 pairs of shoes. The value of cellulose as a raw material is continually increasing as our knowledge increases.

Fenland Archæology

AMONG the objects which the recently founded Fenland Research Committee, of which Prof. A. C. Seward is chairman, has in view is the preparation and publication of a map, or series of maps, showing the extent of Roman or British occupation of the Fens and of the watercourses as they existed at that period. As was pointed out when the Committee was formed, the scientific investigation of the Fenland to a great extent has been neglected, and if it should be possible to complete the survey for the purpose of this map on the scale contemplated, it will prove of very considerable importance for the study of the physical and human geography of the period. It is estimated that something like a million acres will be added to the map of Roman Britain. In the meantime, an appeal has been issued by the Committee for assistance towards the cost of printing a map of the Fens on the scale of two inches to the mile in a series of twenty sheets, of which four have already been prepared. The maps are to be reproduced by photography from the six-inch Ordnance map and will show all that is shown on that map. It has been found by experience that the two-inch scale is more convenient for survey work than the six-inch, hence the necessity for the reproduction. The maps are intended for use as a basis for the research work of the Committee, especially in connexion with the work of plotting from air-photographs showing abandoned drainage channels, the Celtic, or Romano-British, system of fields and drainage and the like. A sum of £500 is required. Contributions may be sent to the Hon. Secretary, Dr. Grahame Clark, Peterhouse, Cambridge.

Afforestation in Great Britain

IN view of the conditions of drought experienced in 1933, the fourteenth Annual Report of the Forestry Commissioners for the year ending September 30, 1933 (H.M. Stationery Office, 1934) may be read with satisfaction. Since the Commissioners commenced their afforestation work, the only comparable drought in Great Britain was that of 1921; the losses in the nurseries and new plantations were far less in 1933 than in 1921. Equally satisfactory is the comparison of fire losses with those of the bad fire year 1928–29, even though the drought in 1933 was more prolonged. This is attributed to the fact that the whole system of fire prevention and fire protection was overhauled after 1928–29, and with success; since the acreage burnt in 1932–33 was 1,313 compared with 4,574 acres in 1928–29. It is of interest to note that 50 per cent of the fires in plantations during 1932–33 originated from sparks from railway engines, whilst 19 per cent were caused by the general public. With the growing area of coniferous woods in the country, as a public property, it would appear that railway managements should take steps to minimise this wasteful destruction. The Commissioners continued their planting work, the total area dealt with (planted or sown) during the year amounting to 21,037 acres, of which 19,160 acres were conifers and 1,877 acres broad-leaved species. The total area planted by the Commissioners during the fourteen years amounts to 232,711 acres, of which 217,919 acres are under conifers and 14,792 under broad-leaved species. During the same period, 95,228 acres have been planted by local authorities and private owners with the help of State assistance; the area during 1932–33 amounting to 4,580 acres. Land acquisitions during the year amounted to 17,591 acres, 15,335 acres being classified as plantable land. The Commissioner's policy of establishing training camps for the unemployed resulted in five new camps being formed, the total number being thus augmented to twelve.

Agricultural Industries Congress

THE fourth International Congress of Agricultural Industries will be held in July 1935 in Brussels. The third congress was held last Easter in Paris. Many aspects of agricultural research and technology were considered, including the importance of pH (intensity of alkalinity-acidity) in agricultural practice; improvement of wheat and sugar beet by genetical methods; fermentation studies, and various other subjects connected with the food industry. The April number of the *Bulletin de l'Association des Chimistes de Sucrerie, de Distillerie et des Industries Agricoles* contains an account of the Congress, the final report and the resolutions passed. The scientific proceedings have been published in a separate volume. As a result of the last Congress, a permanent International Commission of Agricultural Industries has been established in Paris (156 boulevard de Magenta). Its purpose is to organise international congresses and exhibitions and to notify the various States and organisations concerned of the results of such activities. Among the resolutions passed by the last Congress was a recommendation that some suitable international organisation be requested to correlate the present knowledge concerning water pollution by industrial wastes, and to facilitate further study of the conditions that must be fulfilled by water from industrial wastes in order that it shall not be harmful.

Fauna of Caves

A BIBLIOGRAPHY of cave faunas is now being published ("Animalium Cavernarum Catalogus", auctore B. Wolff, Pars 1: Vorwort; Einleitung, Band 1, S. 1–16; Band II, S. 1–32; Band III, S. 1–64. 18 M. Pars 2: Band I, S. 17–32; Band II, S. 33–64; Band III, S. 65–144. 18 M. Berlin, W. Junk, 1934). This work is to be completed in three volumes which will form respectively a biblio-

graphy, a list of the caves and of the animals recorded from each, and a list of the animals found living in caves arranged in systematic order, and will be provided with an index in two parts—an alphabetical list of the caves and another of the animals recorded. The first and second parts now issued contain the first section of the bibliography (32 pp.), of the list of caves arranged according to the countries in which they occur (64 pp.) and of the catalogue of animals recorded—Protozoa, Coelenterata, Vermes, Crustacea and Insecta as far as the end of the Apterygota (144 pp.). The author is rendering useful service in bringing together the widely scattered references on cave faunas in the literature, and in carefully analysing the papers on the subject for the data recorded in the second and third sections of the work.

Romanes Lecture at the University of Edinburgh

Miss Isabella Davidson Romanes, of Edinburgh, who died in 1932, bequeathed to the University Court a sum of £2,000 in memory of her brothers Robert and James, chemists, who graduated B.Sc. in the University of Edinburgh, in 1874 and 1880 respectively. The elder brother, moreover, obtained the degree of D.Sc. in 1876; he was later scientific chemist in the Government School, Rangoon. The University Court has *inter alia* instituted a biennial Romanes lectureship. The first lecture was given on May 24 by Prof. H. Wieland, of Munich, on "Some Enzymic Reactions of Yeast".

Population of Arctic Russia

The Soviet Government has published a map on a scale of 1 to 5,000,000, in two sheets, showing the distribution of people in the northern parts of Russian territory in Europe and Asia, from the Finnish frontier to the Pacific. On a groundwork showing only water features in blue, the various races are shown by twenty-three colours and tints. Squares of colour indicate settlements of different sizes while circles of colour show the density of nomadic peoples. The map is very clear, although the different colours and symbols have to overlap in many places. The data were collected during the census of 1926 and the map has been prepared by P. E. Terlezki for the Northern Tribes Assistance Committee. The legend is in English as well as Russian. The two sheets present a most graphic picture of the distribution of peoples, their relation to river valleys and sea coasts and the meeting and intermingling of various tribes.

Physical and Chemical Apparatus

We have received from Messrs. Griffin and Tatlock, Ltd., Kemble Street, Kingsway, W.C.2, a copy of their illustrated catalogue, No. 50 L, of scientific apparatus. This describes, in 900 pages or more, instruments and apparatus for the physical sciences, including mechanics, sound, heat, light and electricity, with the addition of laboratory fittings and a list of chemicals. The catalogue also contains a very useful classified list of standard textbooks and recent publications on all branches of physics, chemistry and general science. Of special interest to the teacher of physics is the "Microid Physical Series" comprising apparatus and instruments of new and improved design for demonstrating physical principles. This series contains more than one hundred items and we may instance as articles possessing novel features of interest the circular trolley and centrifugal force apparatus, an apparatus for finding "g", a rotating platform for illustrating angular momentum (Pohl), the universal projector, spectrometer, and optical bench, the potentiometer and the earth inductor. A section on microscopy includes an inexpensive micro-projector and drawing apparatus for biological and other subjects. Among technical testing apparatus we find the Griffin–Sutton bomb calorimeter, the Boys' gas calorimeter, and also microid pyrometers. It is gratifying to find that British firms are now active in the design and construction of scientific apparatus.

Applications are invited for the following appointments, on or before the dates mentioned:—A temporary surveyor in the Engineer's Department, River Medway Catchment Board—Engineer, 71a Bank Street, Maidstone (Aug. 31). A principal of the Widnes Municipal Technical School—Secretary, Education Office, Town Hall, Widnes (Aug. 31). A technical assistant with training in electro-acoustics at the Air Defence Experimental Establishment, Biggin Hill, Kent—Superintendent (Aug. 31). A deputy station superintendent at the Pigeon House Steam Power Station, I.F.S.—Secretary, Electricity Supply Board, 60 Upper Mount Street, Dublin (Aug. 31). A lecturer in electrical engineering at the College of Technology and Art, Rotherham—Director of Education, Education Offices, Rotherham (Sept. 1). A lecturer in chemistry at the Portsmouth Municipal College—Registrar (Sept. 1). A director of research of the Research and Standardisation Committee of the Institution of Automobile Engineers—Secretary, I.A.E., marked 'Personal' (Sept. 1). An assistant lecturer in the Department of Physiology, qualified in medicine and preferably with a science degree, at University College, Cardiff—Registrar (Sept. 1). A professor of animal husbandry and lecturers in histology and embryology, in chemistry and physics and in biology at the Royal Veterinary College, London, N.W.1—Secretary (Sept. 3). An assistant in the Botany Department of the University of Aberdeen—Secretary (Sept. 8). A demonstrator in civil engineering, City and Guilds (Engineering) College, chiefly for work in connexion with the theory of structures—Secretary, Imperial College of Science and Technology, South Kensington, S.W.7 (Sept. 8). A county librarian to the Northamptonshire Education Committee—Secretary for Education, County Education Offices, Northampton (Sept. 8). A chief advisory economist for the Midland Province at the Midland Agricultural College—Principal of the College, Sutton Bonington, Loughborough. A sanitary engineer for the Department of Health, Palestine—Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M/3449.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Radioactivity Induced by Neutron Bombardment

USING neutron sources containing up to 250 millicuries of radon mixed with beryllium, we have been able to confirm many of the results reported by Fermi and his collaborators[1]. We have also obtained the following additional results:

Fluorine appears to give an effect of about 40 sec. period, which has an initial intensity of about 5 per cent of that of the shorter period already reported by Fermi.

Zinc. The longer period exhibited by this element appears to be about six hours, and chemical separation shows that the active body is an isotope of copper.

Copper also gives an effect of about six hours period, of the same order of intensity as the effect from zinc: the active body is probably identical.

Sodium. Besides the short period, we have found a very weak effect from sodium the period of which (*c.* 10 hr.) is within the errors of measurement the same as that of the long periods given by magnesium and aluminium, which are known to be due to an isotope of sodium[1]. The active body in each case is probably ${}_{11}Na^{24}$. We are indebted to Dr. Segrè for suggesting that we should look for this period, as it is apparently a definite case of capture of a neutron without expulsion of a material particle, since ${}_{11}Na^{22}$ is known to have a very short period (and to emit positrons)[2].

Search for a period of 13 days from phosphorus, which would be a similar case, was without result.

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Aug. 14.

[1] Fermi and others, *La Ricerca Scientifica*, 5, 1, 283, 330, 452, and 652; 1934. 2, 21; 1934. NATURE, 133, 757, May 19, 1934.
[2] L. Meitner, *Naturwiss*, 22, 420; 1934.

Dependence of Magnetic Induction on the Magnetic Field in Supraconducting Lead

SUPRACONDUCTIVITY is destroyed by a magnetic field, the critical field H_k depending on temperature. Until recently it was held that the magnetic state of a supraconductor could be computed from electrodynamics with the aid of a single assumption that the conductivity is infinitely great right up to H_k. The dependence of the magnetic induction B on the field strength H for this case is shown on Fig. 1 by the thick line.

Starting from Bridgman's hypothesis[1] that the supraconductive and non-supraconductive states could be considered as two phases, to which the laws of thermodynamics might be applied, Rutgers[2] and Gorter[3] derived a relation between dH_k/dT and the jump in the specific heat at the transition point, assuming that in the supraconducting phase the permeability $\mu = 0$, and that in the ordinary phase $\mu = 1$. The relation obtained was in good agreement with the values found for tin at Leyden.

In order to decide the question whether, indeed, two phases exist, it appeared to us important to measure μ as a function of H up to values greater than H_k. In order to gain a general survey, some measurements were made and the results published[4]. We now possess more accurate data, which we should like to report briefly in NATURE.

The experiments were carried out on a polycrystalline rod of lead, 5 mm. in diameter and 50 mm. long, at a constant temperature of 4·24° K. The axis of the specimen was parallel to that of a long solenoid, which produced a homogeneous field. We made use of two different methods, namely:

(1) $\Delta B/\Delta H$ as measured by suddenly changing H in small stages. For these measurements, a spool was tightly wound around the middle of the rod and connected over an amplifier with a ballistic galvanometer.

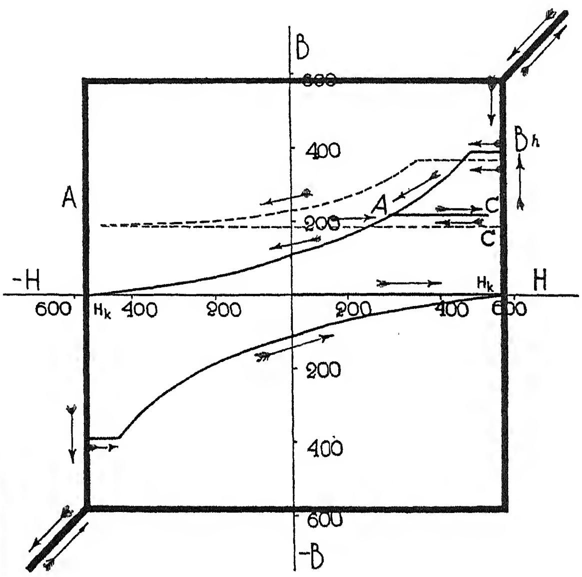

FIG. 1.

(2) The magnetic moment of the supraconductor was measured in a constant field by quickly removing the specimen itself far from the sphere of action of the spool surrounding it. The experiment consisted in observing the throw of the ballistic galvanometer, connected to the spool, when the specimen was suddenly removed or suddenly introduced. In the course of its motion the specimen always remained in a field of constant intensity. Fig. 1 shows the relation which we found between the induction B and the field strength H, represented by a thin line and by the thick line above H_k. The dotted curve was obtained with the first method; the full curve shows the results obtained with the second method, part of which coincided with those gained with the first.

The following conclusions may be drawn from these experiments:

(1) When the specimen is first magnetised, B and also μ are equal to zero with an accuracy of 0·2 per cent, when the field varies from 0 to H_k. This result was found to be independent of time.

(2) In fields near to H_k the induction B increases very rapidly in a very narrow interval of field strength

up to a magnitude corresponding to that of the ordinary metal.

(3) In fields above H_k, B and μ agree with the known data on ordinary metals with an accuracy of 0·2 per cent. $\mu = 1$.

(4) When the field strength is decreased again to values near H_k, the phenomenon is completely reversible. A further decrease of H causes a very rapid fall in B, which, however, suddenly ceases when B reaches a certain value B_h. However, in different experiments carried out with the same specimen, this value was completely non-reproducible. The remaining induction B_h varies from 60 to 80 per cent of the maximum value of B. In some cases B was found to decrease slightly with time. Violent shaking of the specimen caused no noticeable change in B.

(5) When H is further reduced, B also decreases. In this part of the curve a considerable discrepancy is discernible between the results obtained with the first and the second method. It may be that the conditions under which the first method may be applied are not fulfilled in this part of the curve. For small values of H the curve obtained by the second method is completely reproducible and does not depend on how far B jumps in the H_k region.

(6) At $H = 0$, the specimen always retained a residuary induction, which was fairly well reproducible and equal to 18 per cent of the maximum value of B at the moment of transition, as measured with the second method.

(7) When H is increased in the negative sense, the residuary magnetisation decreases. Along the entire falling portion of the curve a return to a former value of the field strength causes no change in the induction. (Compare line AC on Fig. 1.) When the field strength equals $-H_k$, the residuary induction vanishes, and a further change in the field-strength leads to a completely symmetrical cycle.

Our experiments show that in the vicinity of H_k a sudden change occurs in B with increasing as well as decreasing field strength. These results do not agree with the former concept of a supraconductor, in which, when the field-strength is decreased, the induction should be maintained constant by means of induced persistent currents (Fig. 1). The actual fact that a jump takes place in the induction in falling field strengths we are inclined to ascribe to the formation of a new phase with $B = 0$.

We hope to obtain a more simple relation between B and H for single crystals, with which we have begun experiments.

At $H = 0$, the persistent currents give rise to a residuary magnetic moment in a supraconductor. Mendelssohn and Babbitt[5], apart from ourselves, observed this phenomenon in a sphere of tin and found the residuary moment to be 1/6 of the maximum moment at the point at which supraconductivity is destroyed.

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July 3.

[1] P. W. Bridgman, 4-ième Conseil Solvay, 286; 1924.
[2] P. Ehrenfest, *Leiden Comm.*, Suppl. 75b.
[3] C. I. Gorter, *Arch. Mus. Teyler*, 7, 378; 1933.
[4] Rjabinin and Schubnikow, *Sov. Phys.*, 5, 641; 1934.
[5] Mendelssohn and Babbitt, NATURE, 133, 459, March 24, 1934.

Spectrum of Nickel Hydride

RECENTLY we have observed the spectrum obtained by introducing nickel carbonyl vapour into the flame of a Meker burner. Just above the blue-green cones, in the hottest part of the flame, we find a very wide-spaced band structure which can only be attributed to a hydride.

Examination of this wide-spaced structure under high dispersion shows that it consists of two well-defined bands, degraded towards the red, with heads at λ5712·6 and λ6245·9. These show well developed P branches, slightly weaker R branches, and Q branches which start with high intensity and quickly fade out. The general intensity distribution, taken in conjunction with the fact that the continuity of the R and P branches through the origin is broken by six missing lines, indicates that the bands arise from transitions of the type ${}^2\Delta \rightarrow {}^2\Delta$. The term differences show that the bands have a common final level. The initial level of the λ5712·6 band shows marked perturbation. Preliminary estimates of the rotational constants are:

	λ5712·6	λ6245·9
B'	5·6 cm.$^{-1}$	5·5 cm.$^{-1}$
B''	7·6 ,,	7·6 ,,
I'	$4·9 \times 10^{-40}$ gm.cm.^{2}	$5·0 \times 10^{-40}$ gm.cm.^{2}
I''	3·6 ,, ,,	3·6 ,, ,,

We conclude that the spectrum is to be attributed to the molecule NiH. This is supported by the observation that the same structure is obtained when a discharge from a 10,000 volts transformer is passed between nickel electrodes in a flame of hydrogen burning in air.

The hydride bands fade out towards the top of the flame, where they are replaced by a second, much more closely spaced, system of bands believed to be due to the oxide NiO. In addition, the flame shows two groups of nickel lines; the first between λ2300 and λ2480 is restricted to the base of the flame; the second between λ3000 and λ3900 extends through the whole of the flame. The bands of C_2, CH and OH, which are also observed, occur in the spectrum of the flame alone.

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Conductivity of Tellurium

THE influence of relatively few foreign atoms on the electron properties of tellurium supports A. H. Wilson's theory[1,2] of semi-conductivity. The accompanying curves (Fig. 1) illustrate the decrease in the electrical resistance of tellurium by the addition of copper and antimony.

This high sensitiveness to impurities explains the lack of agreement among various investigators as to the specific resistance of tellurium. The conductivity of the tellurium we studied could be entirely attributed to an impurity of about 0·01 per cent antimony or bismuth, so that it seems possible that ideally pure tellurium would have a much higher resistance than has been observed. This assumption is strengthened too by its abnormal thermoelectric power[2].

The addition of 0·2 per cent antimony or bismuth to our tellurium caused the electrical conductivity to increase about a hundred times and the temperature resistance coefficient to change from negative

to positive. These facts can be explained by assuming that the foreign atoms play a double rôle: (1) furnish free electrons (or holes) by Wilson's mechanism (increases conductivity); and (2) scatter electron waves in the manner accepted for ordinary metals (decreases conductivity)[3]. Is the first process also present in ordinary metals? Calculation shows that

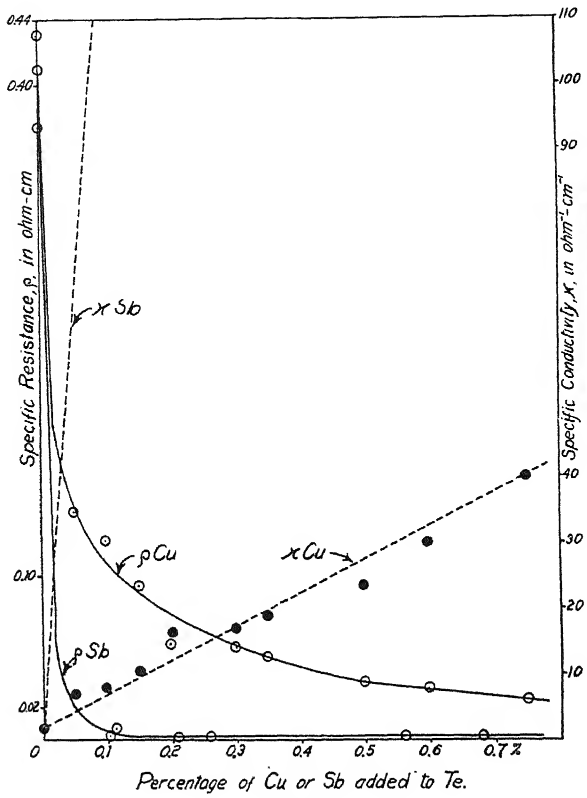

FIG. 1.

when few free electrons are present (semi-conductors) the first mechanism predominates; when many free electrons are present (conductors), the second. Wilson's mechanism, if present in ordinary metals, is masked and can be assumed without contradicting experience (for example, the Matthiessen rule for conductors).

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June 26.

[1] A. H. Wilson, *Proc. Roy. Soc.*, A, **133**, 458; 1932. **134**, 277; 1932.
[2] R. H. Fowler, *Proc. Roy. Soc.*, A, **140**, 505; 1933.
[3] W. V. Houston, *Z. Phys.*, **48**, 449; 1928.

Magnetism of Tin

IT is well known that the diamagnetic susceptibility of colloids of graphite and bismuth depends on the size of the colloidal powders[1]. The specific intensity of magnetisation of a ferromagnetic metal like nickel also shows a similar dependence on particle size[2]. An investigation was therefore carried out with tin to study the effect of colloidalisation on its magnetic properties.

White tin has a small paramagnetic susceptibility[3] of $0\cdot025 \times 10^{-6}$, while grey tin is strongly diamagnetic, its susceptibility[3] being $0\cdot35 \times 10^{-6}$. A sample of pure white tin powder was carefully sorted out by settling in propyl alcohol and centrifuging. It was found, on testing the colloidal powders magnetically, that as the particle size decreases, the susceptibility becomes diamagnetic, this diamagnetism attaining larger values for smaller particle sizes. On melting and recrystallising, the substance becomes once again paramagnetic. Careful experiments showed that these results were not due to chemical or ferromagnetic impurities. It seems, therefore, most likely that the paramagnetic susceptibility of white tin is not an atomic property, but is dependent on the crystal structure of the metal in some manner which at present is uncertain. Full details will be published elsewhere.

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June 30.

[1] See, for example, *Ind. J. Phys.*, **6**, 241; 1931. **7**, 35; 1932.
[2] *Phys. Rev.*, **44**, 850; 1933.
[3] "International Critical Tables", vol. 6, p. 355.

Induced Positron Radioactivity

RADIOACTIVITY induced by proton, diplon, neutron and α-particle bombardment can be explained on the hypothesis that the nuclear structure of stable isotopes consists of α-particles, neutrons and diplon. Missing isotopes of mass number less than twice the atomic number contain, on this theory, a free proton in addition to the other nuclear components[1]. Such nuclei are unstable and radioactive, emitting positrons. They may be produced artificially by bombarding appropriate stable isotopes with protons, diplons or α-particles but, being short-lived, have not at present been detected. These positron radioactive isotopes will only be found among elements below scandium in the periodic table, and are of the structural type, for example, $_7N^{13}$ $(3\alpha + p)$, $_6C^{11}$ $(2\alpha + D + p)$, $_{15}P^{30}$ $(7\alpha + p + n)$.

Accordingly, the following radioactive isotopes are possible:—

Type 1. $_3Li^5$, $_7N^{13}$, $_9F^{17}$, $_{11}Na^{21}$, $_{13}Al^{25}$, $_{15}P^{29}$, $_{17}Cl^{33}$, $_{19}K^{37}$, $_{21}Sc^{41}$.

They are produced by bombarding the corresponding stable isotopes, $_2He^4$, $_6C^{12}$, $_8O^{16}$, $_{10}Ne^{20}$, $_{12}Mg^{24}$, $_{14}Si^{28}$, $_{16}S^{32}$, $_{18}Ar^{36}$, $_{20}Ca^{40}$ with protons or diplons. If the bombarding particles are diplons, neutrons will be emitted during the formation of the radioactive isotopes, for example:

$$_{14}Si^{28}\,(7\alpha) + p \rightarrow {}_{15}P^{29}\,(7\alpha + p) \rightarrow {}_{14}Si^{29}\,(7\alpha + n) + \overset{+}{e}\nearrow$$

$$_{14}Si^{28}\,(7\alpha) + D \rightarrow {}_{15}P^{29}\,(7\alpha + p) + \overset{\nearrow}{n} \text{ and}$$

$$_{15}P^{29} \rightarrow {}_{14}Si^{29} + \overset{+}{e}\nearrow.$$

Type 2. $_2He^3$, $_6C^{11}$, $_8O^{15}$, produced by bombarding $_1H^2$, $_5B^{10}$, $_7N^{14}$, respectively, with diplons. Neutrons will be emitted during the formation of the radioactive isotopes.

Type 3. $_{11}Na^{22}$, $_{13}Al^{26}$, $_{15}P^{30}$, $_{17}Cl^{34}$, $_{19}K^{38}$, $_{21}Sc^{42}$, produced by bombarding $_9F^{19}$, $_{11}Na^{23}$, $_{13}Al^{27}$, $_{15}P^{31}$, $_{17}Cl^{35}$, $_{19}K^{39}$ with α-particles. Neutrons are emitted during the bombardment, followed by positrons from the radioactive isotope.

The following isotopes of type 2 are also

radioactive :—$_{10}Ne^{19}$, $_{12}Mg^{23}$, $_{14}Si^{27}$, $_{16}S^{31}$, $_{18}Ar^{35}$, $_{20}Ca^{39}$. They are formed when an α-particle in the normally stable isotopes, $_{10}Ne^{20}$, $_{12}Mg^{24}$, $_{14}Si^{28}$, $_{16}S^{32}$, $_{18}Ar^{36}$, $_{20}Ca^{40}$, possess excess energy such as suggested by Oliphant, Harteck and Rutherford[2]. These 'excess-energy' isotopes lose energy emitting a proton or a neutron. The emission of a neutron results in the formation of the radioactive isotope.

In these radioactive transformations the free proton within the nucleus emits a positron and is transformed into a neutron.

F. H. NEWMAN.
H. J. WALKE.

Washington Singer Laboratories,
Exeter.
July 24.

[1] See Walke, *Phil. Mag.*, 18, 156 ; 1934.
[2] *Proc. Roy. Soc.*, A, **144**, 692 ; 1934.

Galvanometer Amplification by Photo-Cell

I REFERRED recently[1] to the use of a Weston 'photronic' cell arranged differentially for amplifying galvanometer deflections. It has been found since, (*a*) that a Bernheim cell is several times as sensitive, and (*b*) that there is considerable advantage in cutting the cell into two halves, and opposing the two halves *in parallel*. In the previous arrangement the conducting surface only was divided, and contacts made to its two halves: the two half-cells were thus opposed *in series*. With the new arrangement (i) there is at least twice the current in an ordinary low resistance galvanometer for a given difference of illumination, and (ii) for equal illuminations of the two halves there is no current.

A. V. HILL.

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July 27.

[1] NATURE, **133**, 685, May 5, 1934.

Direct Proof of the Existence of Metastable Molecules in Active Nitrogen

THE two bands λ2760·6 and λ2603·8, which are the (0,6) and the (0,5) bands respectively of the new band system discovered by me recently in gaseous nitrogen[1], have now been observed in the nitrogen afterglow. These bands originate on the $A^3\Sigma$ state, and their appearance in the afterglow provides direct proof of the existence in it of metastable molecules. The tube, in which the afterglow was photographed, was running in the so-called green stage[2], corresponding to the lowest current at which it will show an appreciably strong afterglow. In this afterglow are also present both second-positive and first-positive bands, which originate on vibrational levels higher than those that normally occur in electrical discharges in nitrogen. In fact, *it* is the presence of these first-positive bands that gives both the afterglow and the discharge their characteristic green-white colour.

In a symposium on spectroscopy in astrophysics, which was held at the joint meeting of the Astronomical Society of the Pacific and the American Physical Society in Berkeley on June 19, I directed attention to the fact that the light of the night sky consists of radiations which can best be explained as bands belonging to the first-positive, the second-positive and the new $A^3\Sigma \rightarrow X^1\Sigma$ systems. In particular, bands originating on high vibrational states seemed to be involved in the explanation of the light of the night sky. The presence in the afterglow of all three of these systems definitely establishes the plausibility of my hypothesis. It is proposed to take photographs of even weaker afterglows in order to test further my view that the light of the night sky is a very weak afterglow of nitrogen.

JOSEPH KAPLAN.
University of California at Los Angeles.
July 20.

[1] Kaplan, *Phys. Rev.*, **45**, 675 ; 1934.
[2] Kaplan, *Phys. Rev.*, **45**, 671 ; 1934.

Kinetics of Photosynthesis

BALY and Morgan[1] have proposed kinetic equations which account for observations of Warburg[2] and Emerson[3] on the rate of photosynthesis. We wish to direct attention to one of Warburg's observations which is not in accordance with their equations. At low light intensities, the temperature coefficient of photosynthesis approaches unity, while at low carbon dioxide concentrations it remains high. We have confirmed this for five different species of algæ. This leads us to suppose that carbon dioxide is a reactant in the temperature-sensitive reaction, rather than in the photochemical reaction, where Baly and Morgan placed it. Their assumption seems to us untenable because it leads to equations in which light intensity and carbon dioxide concentration are interchangeable, and because according to photochemical principles a photochemical primary process is unimolecular, taking place immediately on the absorption of light.

Emerson and Arnold's[4] observation that the maximum yield in flashing light is reduced by lowering the carbon dioxide concentration indicates that carbon dioxide enters the process prior to the light reaction. If we assume that carbon dioxide, P, and chlorophyll, a, combine in the Blackman reaction to form the intermediate substance x, and that the absorption of light by x leads to the formation of products of photosynthesis and uncombined a, then under stationary conditions, when both reactions proceed at equal rates

$$y = k_1 I x = k_2(a - x)\, Pe^{-Q/RT} \qquad (1)$$

where y is the rate of photosynthesis, a represents the total chlorophyll in the system, and I the light intensity. Following Baly and Morgan, we divide by $k_1I(a - x)$ and let $K - y = k_1I(a - x)$, and (1) leads to

$$\log \frac{y}{K - y} = \log \frac{k_2 P}{k_1 I} - \frac{Q^1}{T} \qquad (2)$$

where $Q^1 = \frac{Q}{2{\cdot}303R}$. (2) is in agreement with Emerson's[3] observations on *C. vulgaris* photosynthesis at different temperatures, just as is Baly and Morgan's equation (2), because these equations are identical except for the constant term.

The elimination of x from (1) gives

$$y = \frac{k_1\, k_2\, I\, Pae^{-Q/RT}}{k_1 I + k_2 Pe^{-Q/RT}}. \qquad (3)$$

This corresponds to Baly and Morgan's equation (3),

and is in qualitative agreement with the observations discussed in the first paragraph. If I is small, y becomes independent of temperature, while if P is small y remains a function of temperature. The stoichiometric equations from which we have derived (2) and (3) are in agreement with the majority of observations on rates of photosynthesis. A bimolecular Blackman reaction is involved, instead of the monomolecular one proposed by Baly and Morgan, but their statement that the Blackman reaction is monomolecular appears to be without substantial support.

ROBERT EMERSON.
LOWELL GREEN.
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Pasadena, California.
June 7.

[1] NATURE, **133**, 414, March 17, 1934.
[2] *Biochem. Z.*, **100**, 230; 1919.
[3] *J. Gen. Physiol.*, **12**, 623; 1929.
[4] *J. Gen. Physiol.*, **15**, 391; 1932.

Action of Phenyl *Iso*cyanate on Insulin

DURING the past three years, we have been investigating the properties of proteins which have been treated with phenyl *iso*cyanates[1]. This reaction is of special value for the introduction of new groups into proteins, since it is rapid and can be carried out in neutral or faintly alkaline solution (pH 7–8) and at relatively low temperatures (5°–8° C.).

The new protein compounds produced by this reaction have been studied by chemical and immunological methods, and these investigations show that phenyl *iso*cyanate appears to react only with the free amino-groups of the protein. These free groups, from the chemical evidence of other authors and from the immunological evidence which we have presented, appear to be the ε-amino-groups of the lysine molecules.

In addition to the application of this reaction to some problems of immunological chemistry, it was thought desirable to make use of it for other purposes, and with this object in view we have studied the action of phenyl and p-bromophenyl *iso*cyanates on insulin. (For a generous supply of insulin for this work we are indebted to Messrs. Boots Pure Drug Co., Ltd., Nottingham.) In particular, it was hoped that this investigation might yield useful information about the active groups of insulin, a problem which has received much attention during the past few years. In a very recent review of the chemistry of insulin by Jensen and Evans[2], mention is made of some unpublished investigations by Jensen, Evans and Schock on the treatment of insulin with phenyl *iso*cyanate. In view of this, it is of interest to record our own observations and to give a brief outline of the conclusions which we can draw from our previous chemical and immunological studies.

Treatment with phenyl or p-bromophenyl *iso*cyanate rapidly causes complete or almost complete destruction of the activity of insulin. This inactivation is very rapid and is practically complete in 10 minutes at 5°–8° C. From our previous work on similar compounds, we can conclude that the *iso*cyanate reacts with the free amino-groups of the insulin, and not to any significant extent, under the conditions of our experiments, with the hydroxyl groups of the tyrosine. Insulin appears to contain free amino-groups in addition to those of the lysine molecules, since a value of 1·00 per cent[3] has been given for the amino-N of an insulin of potency 25 units per mgm., but insulin contains only 2 per cent of lysine[4].

Preparations of p-bromophenylureido-insulin which we have made have been found to contain 4·8, 5·5 and 5·0 per cent of bromine, and the theoretical value for complete reaction with all the free amino-groups is 5·0 per cent. Thus phenyl and p-bromophenyl *iso*cyanates probably react with all the free amino-groups, including the ε-amino-groups of the lysine molecules. The basic groups of insulin appear, therefore, to be important for the physiological activity of insulin, a view which was tentatively suggested by Jensen[5] in 1932.

S. J. HOPKINS.
A. WORMALL.
Department of Physiology,
University of Leeds.
July 11.

[1] Hopkins, S. J., and Wormall, A., *Biochem. J.*, **27**, 740 and 1706; 1933. **28**, 228; 1934.
[2] Jensen, H., and Evans, E. A., *Physiol. Rev.*, **14**, 188; 1934.
[3] Freudenberg, K., Dirscherl, W., and Eyer, H., *Z. physiol. Chem.*, **202**, 128; 1931.
[4] Jensen, H., and Wintersteiner, O., *J. Biol. Chem.*, **98**, 281; 1932.
[5] Jensen, H., *Science*, **75**, 614; 1932.

Hive-Bees do not necessarily Sacrifice their Lives when they Sting

MY scepticism regarding the frequent statement, for example, Bischoff[1], that worker bees (*Apis mellifica*) cannot withdraw their barbed sting, and thus invariably die when they have stung, was first aroused by observing a raid by wasps (*Vespa germanica*) on a hive in Essex, in September 1926.

In one case a wasp made a bold entrance by the doorway, was met by a bee and vigorously repulsed. It entered again, and emerged at once, struggling with a bee, which eventually succeeded in throwing it to the ground. The bee seemed somewhat exhausted; but it recovered completely. The wasp fell helpless, and died a few minutes later.

Experiments with bees showed that, when induced to sting a handkerchief, some of them, perhaps a third, finally get the sting into a position from which they cannot extricate it, the whole gland and vesicle tearing out in their struggles. But many penetrating stabs are followed by successful withdrawal.

Eight insects were killed by making hive-bees sting them. These were muscid maggots and flies, chiefly *Calliphora*, a small acridiid grasshopper, and an *Eristalis*. Some died in a few minutes. All were dead within twenty-two hours. A frog was stung several times, the frog hopping away on one occasion with the bee hanging by its sting. The bee succeeded in withdrawing and re-stowing it, and appeared none the worse. I was stung on the thumb, and perhaps because it was unexpected and I acted more violently than our other subjects, the sting was left in the wound. In all the other cases, however, even when the same bee stung several times, the bee recovered and re-stowed its sting none the worse. There thus seems little ground for the belief that worker bees sacrifice themselves when stinging other insects, or that they are any more handicapped than wasps in defending their nests from such enemies, or that they can sting only once.

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[1] Bischoff, H., "Biologie der Hymenopteren", Berlin, p. 548.

Partnership between Fish and Anemone

THE association between large anemones and brightly coloured fish is so common in all the Indo-Pacific area that it has been noted many times, though strangely Rüppell, who described both the fish and the anemone of the Red Sea in 1828, does not note their association. The latest mention by Yonge in "A Year on the Great Barrier Reef" describes and illustrates the association between the fish *Actinicola percula* and the anemone *Stoichactis*, but here, in the vicinity of the Biological Station of the University of Egypt in the Red Sea, both species are different, the fish being *Amphiprion bicinctus* (Rüppell) and the anemone *Actinia quadricolor* (Rüppell).

The fish are apparently allied species, but the anemones are very different, *Actinia* having large tentacles which can attain a length of 6–8 cm. with a thickness of 1 cm., the body being 20 cm. or so in diameter. Rüppell's drawing was made from a much-contracted specimen. The anemone is found in any part of the harbour reefs where coral is growing from just under L.W.S. to 2 fathoms, and wherever either partner is seen the other will be found within a yard or so, often two fish to each anemone. Occasionally the same fish is partner to a much smaller, grey coloured anemone.

As both fish and anemone will live for weeks in the laboratory, I am able to add to the known habits of the commensals. The fish spends most of its time among the tentacles of the anemone, but should any object be put into its tank it immediately attacks it. If the object is a small fish, such as a 'sardine' (*Atherina*), the *Amphiprion* attempts to seize it by the tail. As the *Atherina* is half again as long as the *Amphiprion* this attempt is fruitless until the prey has come into contact with the anemone's tentacles, which cause instant paralysis, the *Atherina* taking a vertical position, motionless but for a greatly accelerated breathing, at about 240 gasps per minute. The *Amphiprion* attacks again, and after several contacts with the anemone even so comparatively large a fish as *Atherina förskali* is overcome, and is dragged back to the anemone and engulfed.

Amphiprion is thus an active hunter for its host, but its share of the prey seems to be small. The bones of the fish are ejected by the anemone after some hours, and are then picked by the *Amphiprion*, which also nibbles at the anemone's mouth, apparently obtaining some of the half-digested food. It has been stated that *Amphiprion* actually enters the cœlenteron of the anemone, but this has not been observed here, though it can become quite invisible among the tentacles. It has been seen to bite off and eat the end of a tentacle.

The anemone is also more active than expected, the long tentacles are often in motion and changes of shape are frequent. The most interesting observation is that the animal alters its position in the aquarium in order to come beneath the inflowing water jet, and if this is moved the anemone moves correspondingly.

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Infant Self-Help

BRAVO, Infant! Miss Chick and others, through Austrian sufferings, have taught us that, "crying for the light" you make use of it to do your own D-ing. Now comes the welcome news[1], that you are not to be outdone even by the rat: that "mewling and pewking in [your] nurse's arms", you can yet C—alone; in fact, make your own *Antiscorbutic Acid*, from birth up to about five months old—a time at which the doctrine "them 'aves what we 'aves" more or less naturally comes to your aid. Nature, it seems, still favours the now unpopular practice once so powerfully advocated by my old neighbour, the late Samuel Smiles. At the moment, however, the newspapers are full of prayers offered up by headmasters, even in Royal Presence, on prize day, that your dear brothers shall be kept on at school—I suppose to continue learning to be led and that they may develop a full measure of swollen head: they will not even have had enough 'science' put into them to understand the wonderful example you are setting of self-helpfulness. Of course, I assume that the report is no mere report.

I have long been wondering whether milk, at its best, may not be an incomplete food for the mammalian infant: whether Nature may not have arranged to supplement the mother's care. I have sought to learn how early the young of herbivorous animals begin to nibble grass: probably they do so very early in life; the young guinea pig, I believe, at once. I can obtain very little trustworthy information upon this subject.

HENRY E. ARMSTRONG.

[1] NATURE, **134**, 142, July 28, 1934.

Physiological Studies of Fungi

IN his review of my "Researches on Fungi", vol. 5[1], Mr. J. Ramsbottom, referring to the well-known Smut fungus, *Tilletia tritici*, by an unfortunate slip states that I have interpreted "the secondary conidium of Brefeld as a special type of primary sterigma borne by the basidium-body (promycelium)".

As a matter of fact, I have interpreted Brefeld's secondary conidium as a true basidiospore. The secondary conidium of *T. tritici*, in its asymmetrical form and drop-excretion mode of discharge, exactly resembles the basidiospore of every mushroom and toadstool and of every Rust fungus.

A. H. REGINALD BULLER.

The Herbarium,
Royal Botanic Gardens,
Kew.
July 30.

[1] NATURE, **134**, 80, July 21, 1934.

I MUST apologise to Prof. Buller and to your readers for the *lapsus calami* which will be obvious to anyone referring to the preliminary account in NATURE mentioned in the review.

In my opinion Prof. Buller is probably right in regarding the secondary conidium as a basidiospore. What I intended to question was his use of the term primary sterigma for the structure which Brefeld called a primary conidium or basidiospore.

J. RAMSBOTTOM.

Research Items

Tuamotuan Stone Structures. Plans and notes of Tuamotuan stone structures made on the Tuamotu Survey of the Bernice P. Bishop Museum in 1929 and 1930 by Mr. Kenneth P. Emory are published in *Bulletin* 118 of the Museum. The only stone remains of any consequence in the archipelago are the maraes. In pre-European times houses were not built on platforms nor were stone walls erected around dwellings or villages. Many of the maraes were roughly built without the use of any squared stone, but many are carefully built and faced with neatly fitted slabs. Megalithic slab uprights trimmed to a conventional shape stand on the platforms in front of them and out on the court. Some of the courts are enclosed by low stone walls. The maraes in the western part of the archipelago have suffered much. Except in the extreme eastern part of the archipelago the maraes of one island differ little from those of another. Throughout they have an unpaved court, quadrangular with a platform at one end ranging from 10 to 80 ft. in length, 2 to 10 ft. in width, and 1 to 5 ft. in height. Along the rear edge of the marae are planted three or more upright slabs, and there is a tiny platform out on the court, placed midway between its sides. The *ahu* uprights range from 2 to 9 ft. in height. The tiny court platform may bear an upright and other smaller uprights may stand on the court. The only stone suitable for building is supplied by outcropping or uncovered limestone ledges. Rectangular slabs of limestone completely dominate the stonework of Tuamotuan maraes. When set on end these slabs serve as uprights. Orientation to the cardinal points was not practised.

Biology of *Calanus Finmarchicus*. The continuation of the important researches of Dr. A. G. Nicholls and Miss S. M. Marshall (*J. Marine Biol. Assoc.*, 19, No. 1; 1933) adds much to our knowledge of this copepod ("On the Biology of *Calanus finmarchicus*". (1) "Reproduction and Seasonal Distribution in the Clyde Sea-Area during 1932" by A. G. Nicholls. (2) "Seasonal Variations in the Size of *Calanus finmarchicus* in the Clyde Sea-Area" by S. M. Marshall. (3) "Vertical Distribution and Diurnal Migration in the Clyde Sea-Area" by A. G. Nicholls). It is found that *Calanus* passes the autumn and early winter mainly in Stage V. The minimum number occurred in April in Loch Fyne, in general the total numbers being high in September in 1931 and falling steadily to a minimum in March. A sudden increase occurred in May and numbers rose to maximal values, with a sudden decline. Three plainly marked breeding seasons were observed between February and July. The egg developed into an adult in four weeks, the total life of a *Calanus* during summer being about two and a half months, in winter five to six months. The size was greatest when the temperature was low, least when high, but there were also increases and decreases of size apparently connected with the breeding periods, those at the beginning of the breeding season being large and those at the end small. The greatest number of eggs usually occurred when the females were small. The late stages taken in the top 30 m. were almost invariably smaller than those from deeper water. Ova and nauplii were observed to be most abundant in the top 30 m. Copepodite states I, II and III most abundant above 30 m. and only Stage III in the deeper layers; Stage IV migrated to the surface at night; Stage V was always in the deeper water with slight diurnal changes. Females showed definite diurnal migrations both in January and July. Males migrated in small numbers towards the surface at night and away from it in the day. Stage V and females both lived nearer the surface in January than in July, correlated with seasonal changes in intensity of sunlight. Food must play an important part in controlling these migrations, also light intensity; spawning is probably a third factor which will affect adults only.

'Blackhead' in Turkeys. Blackhead disease in turkeys in the United States is due to the invasion of the tissues of the cæca by the flagellate protozoon, *Histomonas meleagridis*, first recognised by Theobald Smith in 1895. In young turkeys, the disease, which is not uncommon also in Britain, is progressive and almost always fatal; if the bird recovers, the protozoon is eliminated from the tissues but may establish itself in the cæcal contents, in which it continues to multiply for a long period. Such a bird becomes a 'carrier' and its discharges, which often contain great numbers of *Histomonas*, are infective for normal birds. Since *Histomonas* survives for only a brief period in the cæcal discharge, cases of blackhead appearing in young birds that have never been associated with older stock could not be accounted for by direct transmission. H. W. Graybill and Theobald Smith (1920) discovered that blackhead may be produced by feeding large numbers of the embryonated eggs of *Heterakis gallinæ*, the common cæcal worm of poultry, and they offered the tentative hypothesis that the cæcal worms lowered the resistance of the bird to the *Histomonas*, supposed to be already present, and hence the protozoon was able to multiply. E. E. Tyzzer (*Proc. Amer. Acad. Arts and Sci.*, 69, No. 5; 1934) produces experimental evidence to show that *Histomonas* is carried in the embryonated egg of this worm, though it has not yet been possible actually to demonstrate the protozoon in the egg. The hatching of the egg is necessary for the release of the *Histomonas* in the bird's intestine. No other example is known of an intestinal worm serving as the vector of an infectious disease. The author gives details of the morphology of *Histomonas* in the tissues and in culture, records the finding of the protozoon in the epithelium of the intestine of *Heterakis*, and adds observations on the loss of virulence in *Histomonas* in culture and on the immunising properties of an attenuated strain.

Culture of Barley for Brewing. The second Horace Brown Memorial lecture of the Institute of Brewing, delivered by Dr. E. S. Beaven on "The Culture of Barley for Brewing", has now been published in the Institute's journal (*J. Inst. Brewing*, 40, 188–203; 1934). The lecture covers a wide field, but the greater part of it consists of an account of the methods so successfully used by Dr. Beaven in breeding and testing new barley varieties. The environmental factors which affect yield and malting quality in barley are described, and the heritable characters of the crop—productivity, tillering, the "coefficient of migration" and the nitrogen content of the grain—

which provide a basis for selection, are discussed. The successful new varieties bred by Dr. Beaven arose from the crossing of not widely dissimilar races of proved economic worth, which were themselves obtained by selection from the produce of single plants of old established races. Little or no success was obtained by hybridisation of plants of widely differing characteristics. When the selections were made and multiplied, the next stage was to test their value in field conditions. Dr. Beaven, in association with "Student", was a pioneer in the development of modern methods of field experimentation. Though the 'chequer-board' and 'half-drill strip' methods which he describes no longer fulfil the requirements of statistical theory, they have proved of great value in variety testing. The paper concludes with references to recent work on differential response of varieties to environment, and on brewing quality in barley.

Frost Injury to Trees. In *Oxford Forestry Memoirs* No. 16, 1934 (Clarendon Press), W. R. Day and T. R. Peace of the Imperial Forestry Institute discuss the "Experimented Production and the Diagnosis of Frost Injury on Forest Trees". One of the objects of the research is to ascertain the possible relation of frost damage to the occurrence of fungus pests such as *Dasyscypha calycina*, *Phomopsis pseudotsugæ* and others. The experiments were confined to the periods September–November and January–June. It is held that the time thus covered was sufficient to make it evident that, in general, susceptibility increases during the spring, is at a maximum during the summer, and decreases again in the autumn to a winter minimum. The experiments showed that Douglas fir and Sitka spruce are most susceptible to autumn damage. To winter frost Douglas and Scots pine are the most susceptible. Early spring frosts affect European and Japanese larch, Douglas fir and *Thuja plicata*, followed by Scots Pine; oak, which at the beginning of the period is one of the hardiest species, is by the end of it one of the more susceptible. Work of this type is of value, but many foresters would probably agree that it is a slant of frost-laden biting wind which does the greatest harm to young tree growth and often even to old. Refrigerator experiments do not produce this condition. The monograph is illustrated by a series of excellent plates.

The Chad Basin. Perhaps the most interesting—and astonishing—fact about Lake Chad, which is discussed in considerable detail in "The Chad Basin: Geology and Water Supply" by Dr. Raeburn, assistant director of the Geological Survey of Nigeria and Mr. Brynmor Jones (Crown Agents for the Colonies, 4, Millbank, S.W.1) is that this vast sheet of water, covering, according to secular variation, anything from 5,000 to 8,000 square miles, is liable "at a relatively early date" to disappear almost completely from the map of Central Africa, of which at present it forms so notable a feature. There is a danger that the important system of drainage into the lake through the Shari–Logone Rivers, which contribute 76 per cent of the lake's water supply, may be captured by the River Benue, in which case it would be diverted entirely from the Chad Basin. The lake is aptly described as unique among inland seas: notwithstanding its enormous extent, it is shallow, with a mean depth not exceeding 13 ft. and sometimes as little as 3–4½ ft.; its salinity is insignificant; it has no apparent outlet; it lies on the edge of one of the world's greatest deserts, and there are only one or two vantage points from which its waters, concealed behind thick reed banks, can be observed. Much other interesting scientific information is contained in the publication relative to the Chad Basin, which is the largest basin of inland drainage in Africa, occupying an area of roughly 650,000 square miles of tropical grasslands and desert in British and French territory, including an account of the geology of the district, climate and rainfall, the latter being monsoonal in character with fluctuations in irregular cycles, topography and scenery, vegetation, soil and water supply, which is mainly obtained from wells, ranging in the British area down to 300 ft. in depth. A number of the wells are sub-artesian and there are at present no flowing wells in the Basin. The question of water supply is naturally of importance in relation to the development of Nigeria.

Atmospheric Ozone. The results of nearly four years of regular measurements of the amount of ozone in the atmosphere on all sunny days at the Commonwealth Solar Observatory, Mount Stromlo, Canberra, are given in a recent memoir of the Observatory (No. 3) by Mr. A. J. Higgs. The observations are made by the normal photographic method in which spectra of the ultra-violet region of sunlight are measured, and the absorption caused by ozone in the atmosphere is calculated. The work generally confirms the results previously found at other places: there is an annual variation with a maximum in September or October and a minimum in April, while the average value of the ozone content for the year is about 0·27 cm. The Australian observations have also confirmed the connexion found between the meteorological conditions and the amount of ozone, and the usual relation of high ozone in low pressure areas and low ozone in high pressure areas obtains, though the connexion with the absolute value of the surface pressure is small. Estimates of the average height of the ozone in the atmosphere have been made by observations on direct sunlight when the sun is low. The average value of 56 km. is in reasonable agreement with the value found by this method in Europe, but it is now known that this method is unreliable and gives results which are much too high. The work is a valuable contribution to our knowledge of atmospheric ozone.

Generalised Function Theory. In the ordinary theory of functions of a complex variable, a great part is played by monogenic functions, which are closely associated with certain partial differential equations, in particular Laplace's equation. Interesting generalisations of these ideas are contained in V. Volterra's "Équations aux dérivées partielles et théorie des fonctions" (*Ann. l'Institut Henri Poincaré*, 4, fas. 3). Instead of the ordinary functions, which depend upon the co-ordinates of a point in a plane or on a surface, he considers functions of lines, which depend upon the co-ordinates of every point upon a straight or curved line. The field due to an electric circuit is an example of such a function. The term isogenic is then given to a relation between two functions of lines, corresponding to monogenic for ordinary functions. Theorems are found analogous to Green's theorem and Cauchy's theorem, with a partial differential equation corresponding to Laplace's. The work can be extended to any number of dimensions.

Radiolympia 1934

IF the charge be true that the annual Radio Exhibition is increasingly a cabinet-makers' show, yet there is comfort in the disappearance of the worst excesses of the cabinet-maker. The standard of taste in the casing of sets has improved greatly; there are very pleasing models—even a wireless set with a divan built into it is inoffensive. It is certainly not a philologist's show; impressions from different stands may unite into a nightmare which asks whether an all-electric superhet with high note uplift should embody not only a tweeter but also a boffle for the energised dynamic speaker, to eliminate woofiness! The physicist may let himself be soothed by an unqualified assurance that "If Blank is your aerial, even in the most exposed position, there is nothing to fear. Blank is so well insulated, so thoroughly protected that it is impossible for your set to receive a 'direct hit'—the lightning simply cannot get as far as the set—you and your home are perfectly safe from harm". He will certainly be depressed by an offer to measure—for sixpence—an undefined physical quantity (physical since it is read on a dial) called "It".

Turning to the more cheerful aspects of the show, the visitor will find a notable rise in musical quality, no longer wholly obscured by the distressing proportion of loud-speakers retaining an individuality of their own. He will be interested in the pioneer examples of variable selectivity, allowing the user to accept the widest band of frequencies that the disturbance conditions of the moment permit. He will rejoice that the amount of available quantitative data is slowly increasing. He will welcome the emergence of piezo-electric devices from a long sojourn in the laboratory into general use in loud-speakers, microphones, pick-ups (or picks-up). He will note that the extension of the range of acoustic fidelity permitted by the 'tweeter'—the high frequency auxiliary speaker—is a boon, but a boon admixed with accentuated troubles from microphone and transmitter hiss, receiver noise, surface-noise from records, and naturally and artificially generated noise in the medium. All these were benevolently reduced by the loud-speaker's neglect of the high audible frequencies; all come into prominence along with the welcome overtones of the desired sound. He will see another stage in the progress of magnetic materials, marked by the public 'release', in time for the show, of magnets in the nickel-aluminium-iron alloys.

In vacuum tubes, the new 'universal' valves for A.C./D.C. use, and the wide range of multiple valves for automatic volume control of varying complexity, are the special features of 1934. The 'octode' brings within sight the day when a decision on the appropriate lubricating consonant for a 'dodecahode' and an 'icosahode' will be required. Cathode ray tubes of increased size and of reduced size, with and without gas-filling, are among the rare harbingers of the television show which must be expected about 1936. A very neat and versatile cathode ray oscillograph equipment for direct connexion to mains is a specially attractive exhibit.

The Post Office repeats and extends its valuable demonstration of the interference due to electrical plant, and of its reduction. The somewhat curiously entitled "Physical Exhibit" is supplemented by a cinematograph film which the physicist would not willingly exclude from the category of "physical exhibits".

The Department of Scientific and Industrial Research is a newcomer to the Exhibition, with a special exhibit called "The Radio Weather House". Here the work of the Radio Department of the National Physical Laboratory, for the Radio Research Board, is illustrated by a talking film and by experimental demonstrations. The film, made by G.B. Instructional Ltd. in co-operation with the Laboratory, is an interesting and markedly successful experiment in instructional films; it is a well-planned and well-photographed exposition of the principles of the cathode ray oscillograph and its application in radio research. The only obvious break in an exceptionally clear and logical pictorial argument is the evasion of explanation of how the resultant of two equifrequent but not cophasal simple harmonic motions becomes an ellipse. It is understood that the two reels of this film on "The Cathode Ray Oscillograph" are intended as the introduction to a projected series of films on radio research; the further films of the series will be awaited with interest.

The "physical exhibits" of the collision preventer, the course-deviation indicator, the cathode ray compass, and the acoustic analogy of echo-sounding of the ionosphere have been noticed in our columns when they were shown to more specifically technical audiences. They have been ingeniously adapted, and supplemented by animated diagrams, for the present occasion. The Department of Scientific and Industrial Research and the Radio Manufacturers' Association are to be congratulated on the co-operation which has enabled the methods and products of radio research to be illustrated to a considerable proportion of the quarter million visitors to this exhibition.

Epidemiology of the Nosu, Western Szechwan, China*

THE independent Nosu tribes of Western Szechwan, known to the Chinese by the derogatory title of the Lolo, occupy a territory of about 11,000 square miles in the bend of the Yangtse River and according to one estimate number so many as 1,500,000. Politically their country is within the Chinese Empire; but it forms a part of the foothills of Tibet. Information about these isolated inbreeding tribes is meagre and vague.

In 1932, an expedition to study the Nosu tribes, and more particularly their epidemiology, was organised by Dr. W. R. Morse, professor of anatomy and anthropology at the West China Union University, on a commission from Harvard University. The report on the work of the expedition, in addition to descriptive notes and a record of the journey, deals with blood pressure, surveys general diseases, and sets out observations on the eyes and teeth. Physical anthropology will be treated separately.

* The Nosu Tribes of Western Szechwan: Notes on the Country and its Peoples and on the Diseases of the Region. By Drs. E. R. Cunningham, Leslie G. Kilborn, James L. Maxwell, W. R. Morse and Harrison J. Mullett and F. Dickinson, with a Foreword by Dr. Maxwell. The Department of Field Research, Henry Lister Institute, Shanghai. Supplement to the *Chinese Medical Journal*, March 1933. Pp. 56.

The social organisation of the Nosu tribes is of great interest. Each tribe is divided into two groups or castes, the Black Bones and the White Bones. Each marries only within the group, but the latter are a little the more civilised, as they have adopted Chinese customs to a limited extent. The Black Bones are the influential ruling and leading class, hereditary aristocrats. They do not work and do not wash themselves. They have unlimited power of life and death over the White Bones and slaves. The White Bones are the servile and inferior class. They live under the protection of Black Bones, are comparatively clean, industrious, and carry on trade with the Chinese. They always walk instead of riding horses as do the Black Bones. A Black Bone may be degraded to the status of a White Bone for various reasons, among these being defeat and capture by Chinese. Apparently both Black and White Bones belong to the same stock.

They have a written language of which knowledge is confined to the shamans.

Dr. Kilborn, reporting on blood pressure, compares the results with those found in Western, Chinese and African determinations. The most striking fact revealed is that the blood pressure of the Nosu, besides being low, tends to fall to still lower levels as age advances, agreeing in this with results obtained among African natives, but contrary to the tendency in Western civilised peoples. The average systolic pressure is 104·5 mm., the average diastolic, 72·8 mm., and the average pulse pressure 31·7 mm.

Dr. Maxwell's report on disease directs attention to the surprising fact that there is a marked difference in incidence in some of the commonest diseases of the country as between the Chinese and the Nosu. Smallpox, for example, is rare, contrasting strikingly with conditions among the Chinese. This in part, perhaps, but not entirely, is due to the practice of vaccination carried out in certain localities by a modified arm to arm method. A form of typhus and relapsing fever is considered very fatal. Tuberculosis is strikingly absent in all its forms, again contrasting with Chinese conditions. Leprosy showed a surprising frequency. It is probably the most serious disease of the locality, affecting both Chinese and the Nosu. In the more primitive parts the leper is either burnt or buried alive. Syphilis is less common than among the Chinese, but is not rare. Malaria, absent at the higher levels, is fully in evidence in the lower valleys; but it does not seem to be severe. Infestation with round worm is the most common affection among children; but of all the fatal diseases, infantile diarrhœa is the worst. The dysenteries scarcely seem to be common. Chronic indigestion, owing to the diet, is common in adults. Some cases of gastric ulcer and pyloric obstruction were seen. Of skin diseases, few suffer from the almost universal Chinese complaint of scabies. Few external tumours were noted, but information was received of an area of goitre towards the Yunnan border.

Dr. Cunningham reports on the eyes. He notes that the Mongolian fold appears in less than half of the Nosu examined. The position and constancy of the superior lid fold corresponds closely to that of the Occidental. Another fold in the lower lid is practically always present and is particularly well-marked in the child and young adult. The irises were homogeneous, and in colour the highest percentage was found to belong to group number 14 of the Martin-Schultz scale. A number of pathological conditions were noted.

The general impressions gathered from Dr. Mullett's observation of the teeth were of well-developed, well-functioning dental organs in well-formed jaws, the third molars being well developed as contrasted with the Chinese, where impaction or crowding is very prevalent. The teeth were from medium to large, usually presenting a combination of the tapering and ovoid. There is much abrasion owing to the character of the food. 'Mottled enamel' was observed in many cases. Notwithstanding the absence of oral hygiene, caries was practically absent; but disease of the gums was almost universal.

Polyploidy in *Chrysanthemum*

PAPERS continue to appear showing the importance of polyploidy in flowering plants. A recent paper by Shimotomai (*J. Sci., Hiroshima Univ.*, Series B, Botany, Vol. 2, Article 1) summarises a considerable amount of work on the wild Japanese species of *Chrysanthemum* and the cultivated forms.

The fundamental chromosome number is 9. Two of the Japanese species are decaploid, two octoploid, three hexaploid, one tetraploid and four diploid. In geographical distribution, the high polyploids ($6n$, $8n$ and $10n$) occur only on the sea coast, the tetraploid species (*C. indicum*) is both coastal and montane, while only one of the diploid species (*C. nipponicum*) is coastal. Most of the species overlap very little in distribution. It is concluded that the higher polyploid species have been derived from the lower ones through maritime conditions acting as a stimulus. Thus *C. Shimotomaii* ($6n$), found on a short stretch of coast, is derived from the more inland *C. indicum* ($4n$). The still higher polyploids have perhaps been derived from crossings between lower polyploid species.

Chromosome counts in garden forms throw light on their origin. A group of twenty nearly related varieties have 53, 54 or 55 chromosomes and are regarded as derived from the hexaploid wild species. In another group of forty more distinct varieties with large heads and long rays, the chromosome number ranged from 52 to 67. These are much more specialised but are regarded as derived ultimately mainly from the same wild species, *C. japonense* and *C. Shimotomaii*.

Various crosses were made between wild species of chrysanthemum with different chromosome multiples, and these gave mostly true-breeding hybrids. Thus *C. japonense* ($n = 27$) $\times$ *C. pacificum* ($n = 45$) gave a constant hybrid with $n = 36$, except that the length of the ray florets varied from plant to plant. But in certain hybrids higher multiples appeared. For example, *C. Makinoi* ($n = 9$) $\times$ *C. Decaisneanum* ($n = 36$) gave an F_1 with $2n = 72$; and *C. Makinoi* $\times$ *C. japonense* ($n = 27$) produced an F_1 with $2n = 63$. The characters of *C. Makinoi* were more strongly marked in the hybrid, and in meiosis tetravalent and trivalent chromosomes appeared. The $3n$ additional chromosomes appear therefore to have come from *C. Makinoi*. But exactly how a diploid species produced $4n$ germ cells is not yet clear.

Preservation of Inshore Fisheries*

FOR a number of years past, British inshore fishermen have experienced difficult times due mainly to scarcity of fish on the grounds which they work. The problem of how best to bring about an improvement in these fisheries is a very difficult one which, for some considerable time, has occupied the attention of local fishery committees and other interested bodies. It is generally agreed that the capture and destruction of young fishes, too small to be landed and exposed for sale as a food commodity, are against the best interests of any fishery. With only one exception, the fishing methods at present in general use do not cause wasteful destruction of young stages. There cannot be the least doubt, however, that trawling works great havoc amongst fish stocks by indiscriminately capturing and killing not only marketable but also the small unmarketable members. The most obvious and satisfactory way, therefore, of preserving fish populations and maintaining successful fisheries, would be to prohibit trawling altogether. For many reasons such drastic action cannot be taken. What then are the other possibilities, if any ?

An effort to obtain accurate and adequate data upon which to base a satisfactory answer to this question has been made by Mr. H. J. Buchanan-Wollaston, of the Ministry of Fisheries Laboratory, Lowestoft. For the locus of his researches, extending from 1924 until 1929, Mr. Wollaston chose the English Channel coast and worked mainly from Poole (Dorset) and Beer (Devon). At both of these small ports a very active inshore fishery is carried on.

A comprehensive report on these researches, together with recommendations bearing upon protective legislation, has now been published. This report, states the author, is specially addressed to inshore fishery committees and to the fishermen themselves. To the former it is intended to serve as a guide in dealing with the fisheries over which they have legislative control, and to the latter as a help in deciding whether or not protective legislation is desirable.

Concerning the problem with which he deals, the author is able to state definitely that any attempt to increase the stock of fish on a restricted inshore ground by transplantation seems not to be practicable, at any rate so long as the present methods of wasteful fishing are allowed to continue unregulated. In March 1926 and in May 1927, small plaice were transported from certain Dutch nursery grounds to Poole Harbour with absolutely negative results, so far as any benefit to the local fishery was concerned.

Numerous other experiments and observations carried out by Mr. Wollaston support the view that the enforcement of a minimum size of trawl mesh—the actual measurements to differ slightly in different localities according to the various conditions peculiar to them—would be beneficial. The entire closure of certain bays and similar areas which act as nurseries and/or sanctuaries for the young stages is also discussed in the report. For various reasons, the author hesitates unreservedly to recommend this procedure, at any rate within the area with which he is dealing.

Mr. Wollaston is to be congratulated on having demonstrated very successfully how productive of useful data can be the intensive study of a local fishery in a restricted area, carried out from very minor fishing ports.

* Ministry of Agriculture and Fisheries. Fishery Investigations, Series II, Vol. 13, No. 1, 1933: Inshore Trawl Fisheries of Dorset and Devon. By H. J. Buchanan-Wollaston. Pp. 69. (London: H.M. Stationery Office, 1933.) 3*s*. 6*d*. net.

Structure of Proteins

IN the April issue of the *Berichte der Deutschen Chemischen Gesellschaft*, Prof. Abderhalden and Herr Heyns describe the synthesis and characterisation of three amino-hydroxy-fatty acids, which are of considerable interest to biochemists, since they have for some time been regarded as structural units in the building up of proteins, although the constitution of the actual products of hydrolysis of these proteins has never been completely established. The three acids studied are the α-amino-β-hydroxy derivatives of *n*-butyric, *n*-valeric and iso-valeric acids, of which the last two are called β-hydroxy*nor*valine and β-hydroxyvaline respectively.

The synthesis of such compounds is by no means easy, and many different methods were attempted before success was attained. β-Hydroxyvaline had already been synthesised in 1922, although not under that name, by Schrauth and Geller, and their results have now been substantially confirmed. By using ethyl crotonate instead of ethyl ββ dimethyl acrylate as starting-point, the present authors have been able to synthesise α-amino-β-hydroxy-*n*-butyric acid. The addition-compound which the unsaturated ester makes with mercuric acetate and methyl alcohol is decomposed first with potassium bromide, then with bromine. After hydrolysis of the ester, the bromine is replaced by the amino-group and the methoxyl by hydroxyl, when the amino-hydroxy-butyric acid is liberated.

The synthesis of β-hydroxynorvaline was effected by an adaptation of a method devised by Sörensen. α-Chloropropyl ethyl ether was condensed with the sodium derivative of phthalimido-malonic ester and the product hydrolysed.

These methods of synthesis leave no doubt about the structure of the resulting acids, and the latter have been further characterised by means of their phenyl carbimide, benzoyl and phenyl hydantoïn derivatives. Direct comparison with the products derived from proteins by Schryver, Rimington and others was not possible, but it seems certain that they are not identical. Stress is laid on the fact that whereas Schryver's compounds readily yielded dibenzoyl derivatives, two of these compounds benzoylate only at the amino-group, and the melting-point of the dibenzoyl derivative of α-amino-β-hydroxy-*n*-butyric acid is 60° higher than that of the compound previously described under that name. Further investigation of the natural products will be necessary before the discrepancies can be explained.

University and Educational Intelligence

LONDON.—The following degrees have recently been awarded: D.Sc. degree in astrophysics to C. S. Beals (Imperial College—Royal College of Science) for works entitled "The Wolf Rayet Stars" (*Pub. D.A.O.*, 1930), and "Spectrophotometric Studies of Wolf Rayet Stars and Novæ" (*Pub. D.A.O.*, 1934); D.Sc. degree in biochemistry to G. M. Richardson (University College and Imperial College—Royal College of Science) for six works on biochemistry (*Proc. Roy. Soc.*, B, 1934, and *Biochem. J.*, 1931–33); D.Sc. degree in chemistry to T. Malkin (private study) for five published papers dealing with the application of X-rays to structural problems of organic chemistry, together with ten conjoint subsidiary contributions.

SIR WALTER HAMILTON MOBERLY, Vice-Chancellor of the University of Manchester, has been appointed chairman of the University Grants Committee in succession to the late Sir Walter Buchanan Riddell.

THE Carnegie Trust for the Universities of Scotland in its thirty-second annual report directs special attention to the operation during the last five years of its schemes for the endowment of post-graduate research. The principal scheme, under which fellowships, scholarships and grants are awarded, has now been operating for thirty years, during which period scientific investigation in the universities by 1,162 persons has been subsidised by this means to the extent of more than a quarter of a million sterling, the expenditure for the six quinquennia beginning 1903–8 having been: £27,754, £35,698, £27,540, £39,465, £51,047 and £69,268. "What this has meant to the enrichment of the intellectual life of the Scottish universities may in part be inferred," says the report, "from the fact that the total publications received have numbered 227 volumes and 2,002 other original contributions." The problem has been, not to find suitable and well-qualified applicants, but to find sufficient means to finance them, and in order that the amount available should meet the requirements of the situation so far as possible, the value of the individual awards for 1932–33 was reduced, fellows' stipends being lowered from £300 to £250, senior scholarships from £200 to £175 and other scholarships from £175 to £150; and it has now been found necessary to place all scholarships on the uniform level of £150. A welcome indication of better times is afforded by the fact that resignations on account of appointment to salaried posts have again become numerous. Other financial aids to research are provided by the Trust in the shape of grants towards the maintenance of the laboratory of the Royal College of Physicians of Edinburgh, amounting during the last quinquennium to £9,369, and awards to university assistants and lecturers devoting not less than half their time to research, amounting during the same period to £18,329.

EDUCATION in India in 1927–32 is reviewed by Sir G. Anderson, Educational Commissioner with the Government of India in a volume of 274 pages obtainable from the Manager of Publications, Delhi (price 5*s*.). The situation and tendencies disclosed by the review afford but scanty ground for satisfaction with the past or confidence in the future: some are characterised as alarming and there is no support for the theory that the progress of education is qualifying the people of India to rule themselves. Economic distress has been made an excuse for indiscriminate retrenchment instead of being used as an occasion for restraining wasteful and ineffective expenditure, the prevalence of which was demonstrated by the Hartog Committee of 1928. Among instances cited are: the continuance unchecked in Bengal of a reckless and impetuous multiplication of primary schools regardless of quality; the retention of numerous primary schools with only three classes although well known to be almost wholly useless; filling of a large percentage of primary school places with pupils much too old to benefit by the instruction; a growing tendency towards communal separation, involving scandalous waste and inefficiency; the rapid increase in the number of students who throng the colleges and high schools without the qualifications requisite for deriving benefit from the instruction. Since the transfer of educational control in 1921 from the central to the local government, there has been a rapid growth of provincial particularism which may have fostered local initiative but has involved overlapping and extravagance particularly in regard to university education. A strong central educational intelligence service is badly needed. One of the most disastrous faults found throughout the secondary school systems is the preoccupation with the goal of university entrance qualification to the exclusion of all other aims. Ample evidence is to be found in the report that "the educational systems of India need to be recast and adjusted to the requirements of new conditions".

Science News a Century Ago

Death of Sir John Barton

On August 25, 1834, Sir John Barton died at Windsor Castle. He was buried in the cloisters of St. George's Chapel and a memorial tablet was erected to him by command of William IV. For forty-six years he had served as secretary and treasurer first to William IV when he was Duke of Clarence and then to Queen Adelaide. He was born at Plymouth in 1771. At one time Barton was comptroller of the Mint and he made several improvements in coining machinery. One obituary notice of him said that he was the inventor of a floating compass, a hydrostatic balance, a hydrostatic floating lamp, a draw-bench for use at the Mint and an "atometer" with which a millionth of an inch was rendered a sensible measure to the eye. He originated the ornamental effect produced by the decomposition of the rays of light reflected from polished metallic surfaces covered with a series of very minute lines or grooves, ruled upon them by a diamond point, and also a method of producing a cube in a lathe, which he applied to a scheme for the prevention of the forgery of Bank of England notes, by engraving upon these cubes and printing from them an interpolated coloured line.

Whewell on Tides

IN his researches on the tides, Whewell asked for observations made in various parts of the world, and in the *Journal of the Franklin Institute* a letter was published from Prof. A. D. Bache addressed to the Committee of Publications. Writing on August 26, 1834, Prof. Bache said: "It is no doubt well known to you, and to those of your readers who follow the

progress of general science that the Rev. Mr. Whewell, of Trinity College, Cambridge, is engaged in endeavouring to advance the important, and hitherto comparatively neglected, science of the tides, the first results of these investigations being the memoirs on, and map of cotidal lines, contained in the *Transactions of the Royal Society of London*, for 1833. Through the kindness of a mutual friend, I have received the articles, also from the pen of Mr. Whewell, on the subject just referred to, which accompany this note, and which I should feel obliged by your inserting in that part of the *Journal* of the Institute where they will be most likely to meet the eye of anyone who may be disposed to contribute good tide observations to the stocks which Mr. Whewell is now accumulating for the further elucidation of the subject."

Paris Geographical Society and Sir John Ross

On September 1, 1834, Sir John Ross on receiving the Gold Medal of the Paris Geographical Society (*Bull. Soc. de Géog. Paris*, ser. 2, 1), wrote :

"Gentlemen—M. de Bacourt, Chargé d'Affaires de France, has remitted your letter of April 13, accompanied by the gold medal of your Society. I beg to assure the learned and distinguished members of the gratification which I feel, following my return to Europe after a voyage of unusual length and difficulty. Nothing could have afforded me greater pleasure than the honourable and enviable dignity that the Society has conferred. Inspired by these sentiments, the gold medal, awarded in a manner so flattering, will be transmitted to my descendants as a precious witness of the esteem entertained by the Society for my efforts for the advancement of geographical knowledge. I beg you to believe that I am not less sensible of the flattering expressions which marked the occasion of the gift.

Your most obedient and most humble Servant,

John Ross."

Draper on Capillary Attraction

John William Draper (1811–1882), the father of Henry Draper (1837–1882), was born in England but at the age of twenty-one years emigrated to the United States. While a student in the University of Pennsylvania he made experiments on capillary attraction, an account of which was published in the September number of the *Journal of the Franklin Institute* for 1834. After reviewing what was then known of the subject, he said : "This was the state in which I found capillary attraction ; my attention was first drawn to it during those tiresome moments of returning health which follow an autumnal fever. Perhaps, if there be any merit in these experiments, it may hereafter be of service to someone to know that they were begun in sickness and in a land of strangers; they were pursued in all the calamity of family bereavement and in the depths of forests, alike unused to music, to poetry or to philosophy. Solitude if it be conducive to the development of intellect, and favourable to the exercise of thought, is likewise attended with many evils. Though no disturbance arises from the intrusion of the frivolous, yet the counsel and assistance of the wise are wanting, and, indeed, those advantages which are supposed to result from such tranquillity are, for the most part, only fictitious appearances, which like certain other apparitions, everyone can discourse of, but no one can say he has seen."

Societies and Academies

PARIS

Academy of Sciences, July 2 (*C.R.*, 199, 1–104). A. LACROIX : New observations on the distribution of tectites in Indo-China and in the neighbouring countries. GIUSEPPE SANARELLI was elected *Correspondant* for the Section of Medicine and Surgery in succession to the late J. Cantacuzène. BERTRAND GAMBIER : Tetrahedra inscribed in a Σ quadric and with edges tangent to a quadric S. POTOTZKI : The determination of complexes all the congruences of which are W. A. ROSENBLATT : The application of Picard's method of successive approximations to the study of certain partial differential equations of the parabolic type with two independent variables. LÉON MOTCHANE : The distribution of the points of continuity of a function of n variables continuous with respect to each of them. V. NIEMYTSKI : Unstable dynamical systems. HEINRICH HILMY : Movements stable in the Poisson sense and the recurrent movements of a dynamical system. BERNARD KWAL : The tensorial fields which accompany Dirac's electron : the theory of the neutrino and the antineutrino. JEAN PONTREMOLI and [illegible] SERRUYS : The influence of anti-detonants on the velocity of combustion and the temperature of exhaust in internal combustion motors. ANDRÉ COUDER : The compensation of double refraction in astronomical objectives. Discussion of the effects produced in telescope objectives by double refraction due to insufficient annealing. The use of a compensator consisting of a plate of Iceland spar is suggested. Results of experiments made with the large equatorial at the Strasbourg Observatory are given, showing the value of the compensator. J. GAUZIT : The ultra-violet extremity of the spectrum of the night sky. One interesting result obtained was the presence of emission lines in the region of the large absorption band of atmospheric ozone : work in confirmation of this is in hand. FERNAND BALDET : The continuous spectrum of comets. A. PORTEVIN and D. SÉFÉRIAN : Experimental study of the thermal state during autogenous welding. MLLE. N. CHOUCROUN : The superficial electric moments in the interior of a liquid. JAMES BASSET : The influence of pressure on the electrical resistance of a rod of impure zirconium oxide in air. At constant temperature, the resistance of the zirconia rod increases with the pressure. In air at 900° C. a rod having a resistance of 4,500 ohms under atmospheric pressure alters to more than a million ohms under 4,000 kgm./cm.^{2}. LÉON BLOCH, EUGÈNE BLOCH and PIERRE LACROUTE : The analysis of the first spark spectrum of bromine. JEAN BOUCHARD : The influence of viscosity on the decrease of the fluorescent power of solutions of certain colouring materials as a function of the concentration. G. MONOD-HERZEN : The energy of linkage, the mass of the neutron and the grouping of atomic nuclei. WALTER M. ELSASSER : The linkage energies in the radioactive families of uranium-radium and thorium. JEAN PERREU : The heat of crystallisation of hydrated salts in slightly supersaturated solution. JEAN AMIEL : The preparation and explosion temperature of some complex compounds of copper chlorates with the primary amines. PIERRE JOLIBOIS : The chemical reactions in different parts of a tube containing rarefied gas. MARCEL MATHIEU : The study by Röntgen rays of the fixation of acetone

by nitrocellulose. In the experimental arrangement, the effect of the absorption of acetone on the nitrocellulose could be studied continuously. At no stage was there any indication of the formation of a definite compound. The sudden disappearance of the crystalline structure defined the formation of a gel. MAURICE BILLY and MARC ANTOINE FOEX: Mineral precipitations in glasses. Investigations with alkaline glasses (silicate, borate, phosphate) with copper, gold, silver and other metals. MARCEL BALLAY: The preparation of brilliant electrolytic deposits of nickel in the presence of colloids. WENLI YEH: The frequency of the number of isotopes of the chemical elements. The author shows that elements of odd atomic number should have a smaller number of isotopes than either of the neighbouring elements, and deduces that argon should have three isotopes instead of two, chlorine should have only two isotopes and palladium should have three isotopes instead of one. T. KARANTASSIS and L. CAPATOS: Some complex compounds of germanous bromide with cæsium bromide and with the bromides of organic bases. LÉON PIAUX: The influence of various radicals on the characteristic frequency of the ethylene linkage in cyclopentene derivatives. C. V. GHEORGHIU: The mechanism of the ionic dissociation of 2-thio-4-oxytetrahydroquinazoline derivatives and the corresponding oxygen derivatives. GEORGES RICHARD: The action of potassium cyanide on an α-chlorketone. By an abnormal reaction an ethylene oxide derivative is produced. ANDRÉ A. POLICARD: The constitution and absorption in the ultra-violet of the ethyl diphenylmuconates. CHARLES DUFRAISSE and JEAN LE BRAZ: Applications of the antioxygen effect to the problem of fire fighting. The extinction of flames. L. DONCIEUX, R. PAVANS DE CECCATTY and M. SOLIGNAC: The presence of fragments of nummulitic limestone in certain Quaternary pebbles of the region of Médenine. G. SCHNEIDER: Conclusions drawn from some exact measurements of the yield of the thermal springs of Aix-les-Bains: H. VAUTRIN: The orogenesis of the Hermon (Syria) massif. H. S. REED and T. FRÉMONT: The reactions of the root cells of *Citrus* to infection by the mycorrhiza. ANTOINE DE CUGNAC and FERNAND OBATON: Some peculiarities of the floral biology of the Gramineæ. R. FAILLIÉ, R. JONNARD and H. VIAL DE SACHY: The variation of the constriction of the pupil with illumination. PIERRE MOLLARET: Modifications of the chronaxies of antagonistic stimuli under the influence of local and contralateral posture in the dog. H. BORDIER: Some experimental results furnished by the heliochromometer. Applications to meteorology and to climatology. JEAN COURTOIS: The influence of the reaction of the medium on the hydrolysis of α- and β-glycerophosphoric acids by taka diastase. MME. ANDRÉE ROCHE and JOSEPH BRACCO: Contribution to the study of the molecular weight of the globulins of blood serum. RADU CODREANU: The relations between the development of *Symbiocladius rithrogenae* and the growth of its ephemeral host. FRÉDÉRIC DIÉNERT, PIERRE ETRILLARD and MME. MADELEINE LAMBERT: Research on bacteriophage in waters.

CRACOW

Polish Academy of Science and Letters, May 7. T. HUBER: The analogy of a certain problem of the equilibrium of slightly curved thin elastic bars with a simple case of forced oscillations. I. ADAMCZEWSKI: The mobility of the ions in dielectric liquids. In the method used by the author the ions are produced by X-rays. The measurements prove the existence of three kinds of ions in pentane, hexane and heptane. There is a close relation between the mobilities and the viscosity coefficients of the liquids studied. MLLE. A. FATERSON: Re-emission in the fluorescence of the bands of mercury vapour. The experiments confirm the hypothesis of the molecular, and not atomic, origin of the phenomenon of re-emission. L. MARCHLEWSKI and J. ZGLECZEWSKI: The absorption of ultra-violet rays by certain organic substances (37). A. SWARYCZEWSKI: The mono-, bi- and trichromates of guanidine. W. SZYMONOWICZ: Langerhans cells in the tactile hairs. J. ZACWILICHOWSKI: The innervation and sensorial organs of the wings of *Stauroderus biguttulus*.

ROME

Royal National Academy of the Lincei, March 4. T. LEVI-CIVITA: Stationary solutions of Pfaffian systems. G. ARMELLINI: Horizontal diameter of the sun in 1931, 1932 and 1933. The mean of the values obtained in 1931 at four observatories for the solar radius was 961·65″. For 1932, three observers (one ceased measuring) found a diminution, the mean value being 961·56″. In each case a higher result was obtained in 1933, the mean being 961·71″. These variations may possibly be related to the sunspot frequency and to the general activity of the sun. U. BROGGI: Generalised method of Euler's summation. B. SEGRE: Integrals of binomial differentials. G. LAMPARIELLO: A noteworthy class of non-linear differential equations of the second order. (1) Preliminaries and reduction to the first order. F. CONFORTO: Construction of automorphous functions by means of infinite products (1). L. GEYMONAT and M. ZEULI: Generalisation of certain concepts and formulæ of differential geometry of the Riemannian varieties. M. MANARINI: Considerations on the absolute vectorial calculus in a V_3 and on double tensors with a single divergence. A. ROSENBLATT: Non-linear m-harmonic equations with two independent variables (2). R. EINAUDI: Cauchy's problem relating to superficial elastic waves. A. DE MIRA FERNANDES: The unitary theory of physical space and the relativistic equations of atomic mechanics. G. C. WICK: The radioactive elements of F. Joliot and I. Curie. The theory of β-disintegration, recently proposed by Fermi, is applied to the radioactive phenomena lately observed by Joliot and Curie. R. L. GOMES: Dirac's matrices in a Riemannian space. R. ZAÏCOFF: Generalised wave mechanics. (3) Wave equations for positive and negative electrons. Introduction of a Hamiltonian function. General form of the electric quadri-current. S. BERLINGOZZI: Method of preparing aromatic nitro-ketones. Treatment of an aromatic nitroaldehyde with a magnesium aryl halide yields a nitro-carbinol, which gives the corresponding nitroketone on oxidation with chromic anhydride. A. BELLUIGI: Individualisation and determination of buried basaltic dykes and infiltrations by the Wenner geo-electric method. S. SORRENTINO: The presence of an Oligocene soil in the neighbourhood of Buonalbergo (Benevento). L. TREVISAN: Preliminary observations on the fauna of the Cretaceous in Sicily. G. BRUNELLI and G. CANNICCI: Preliminary notes on the chemical and biological

characteristics of Lake Sabaudia (Paola). MARIA VENTURA: Embryological observations on *Manihot palmata*, Muell. *M. palmata* follows the ordinary type of formation of the macrospores. The female adult gametophyte is octonucleate. O. VERONA: Microbiological study of a peaty soil. A. DE AGAZIO: Action of ephedrine and adrenaline on the isolated heart of *Bufo-vulgaris*.

VIENNA

Academy of Sciences, May 11. WILHELM FIGDOR: Generatively increased descendants of *Bryophyllum calycinum*, Salisb. BERTA KARLIK and ELISABETH RONA: Investigations on the dependence of the range of polonium α-rays on the intensity of the radiation, the age of the preparation, and the nature of the foundation. FRANZ HERITSCH: The age of the Trogkofel chalk. RUDOLF WAGNER: The existence of Γ-helical sympodes. FRITZ FRÜCHTL: Adriatic plankton copepods.

May 17. HILMAR SCHUMANN: Petrographic phenomena in the Seckauer Tauern. FRANZ RÜCKER: Reflective power of animal surfaces in the ultra-red region of the spectrum. Even with insects, for which numerous and comprehensive measurements have been made, no general relation between their reflective power and the radiation-climate prevailing in the regions where they occur, appears to exist. KARL MORSCH: β-Ureidocarboxylic acids and dihydrouracils: (1) β-Phenylureidocarboxylic esters and 3-phenyldihydrouracils. GUNTER LOCK: Cannizzaro's reaction (3). The experiments have been extended to halogen derivatives of dihydroxybenzaldehydes and their methyl esters. GEORG WALTER: Action of chlorosulphonic acid on naphthalene. Under certain conditions, the sulphochlorinating reaction is replaced by chlorinating and oxidising reactions. A. LUSZCZAK and L. GRÜN: The colour of mercapto and methylmercapto dyes of α- and β-naphthols. Spectro-analytical investigation of these dyes reveals certain regularities. GUSTAV ORTNER and JOSEF SCHINTLMEISTER: Radioactivity of samarium. FRIEDRICH LAUSCHER and WILHELM SCHWABL: Investigations on the brightness in woods and at their edges. FRITZ KERNER-MARILAUN: Evidence of the climate of the Gosau formation. KARL STRUBECKER: Constructions in Laguerre geometry. HARALD EGBERT HOCHSTETTER: The fauna of the Walbersdorf 'tegel'. ALFRED FRÖHLICH and EMIL ZAK: (1) The ability of lung-tissue to regulate the water-content of the blood of the lungs. The water-content of rabbit's blood is the same in the right and left ventricles. If, however, the blood is thickened by the introduction of glycerin or 20 per cent sodium sulphate solution into the abdominal cavity, the thickened blood is detectable in the right ventricle, but after the blood has passed through the lungs, its water-content rises. (2) Influence of purine derivatives on the permeability of the heart. By these derivatives the penetration of foreign substances, not only into the central nervous system, but also into the heart, is facilitated. HANS MAUTNER and ALFRED EBEL: Influence of soporifics on the course of infections. GABRIELE FEHÉR and LEO POLLAK: Distribution and degradation of injected galactose in the organs of the animal body. W. ANTOPOL and R. RÖSSLER: The heart-action in the dog of vasopressin extracts.

Official Publications Received

GREAT BRITAIN AND IRELAND

Medical Research Council. Fourteenth Annual Report of the Industrial Health Research Board to 30th June 1934. Pp. ii+34. (London: H.M. Stationery Office.) 9*d*. net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 8: The Chemical Constituents of Lichens found in Ireland. *Buellia canescens*, Part 1. By Dr. T. J. Nolan. Pp. 67–71+plate 2. 1s. Vol. 21 (N.S.), No. 9: Derangement of the Digestive Processes in the Milk-fed Calf due to Abnormal Curd Formation in the Fourth Stomach. By E. J. Sheehy. Pp. 73–85. 1*s*. Vol. 21 (N.S.), No. 11: Investigations on the Cryoscopy of Milk. By J. J. Ryan and G. T. Pyne. Pp. 113–122. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Technical College, Bradford. Diploma and Special Day Courses, Session 1934–1935. Pp. 246+20 plates. (Bradford.)

Further Experiments on Cylinder Wear. By C. G. Williams. (No. 7500, B, Class 42, 251.) Pp. 21. (London: Institution of Automobile Engineers.)

Board of Education. Report of the Advisory Council of the Science Museum for the Year 1933. Pp. 47. (London: H.M. Stationery Office.) 9*d*. net.

Birkbeck College (University of London). Philosophy and Politics: being the Sixth Annual Haldane Memorial Lecture, delivered by Prof. Ernest Barker, June 5, 1934. Pp. 18. (London.)

OTHER COUNTRIES

Ministry of Public Works, Egypt: Physical Department. The Nile Basin. By Dr. H. E. Hurst and Dr. P. Phillips. Supplement to Vol. 4: Ten-Day Mean and Monthly Mean Discharges of the Nile for the Years 1928–1932 and Normals for the Period 1912–1932. (Physical Department Paper No. 31.) Pp. vi+259. (Cairo: Government Press.) 50 P.T.; 10*s*.

Government of India: Department of Industries and Labour (Public Works Branch). Irrigation in India: Review for 1931–32. Pp. 51. (Delhi: Manager of Publications.)

The Indian Lac Research Institute. Bulletin No. 18: Modifications of Shellac. Part 1: The Effect of Sulphur. By M. Venugopalan. Pp. 12. (Nankum.) 1 rupee.

Publications of the Kapteyn Astronomical Laboratory at Groningen. No. 46: The Coefficient of Differential Galactic Absorption. By J. J. Raimond, Jr. Pp. ii+46. (Groningen: Hoitsema Bros.)

Field Museum of Natural History. Anthropological Series, Vol. 21, No. 2: The Ovimbundu of Angola. By Wilfrid D. Hambly. (Frederick H. Rawson—Field Museum Ethnological Expedition to West Africa, 1929–30.) (Publication 329.) Pp. ii+89–362+plates 9–92. (Chicago.) 2.75 dollars.

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 13, 1931. iv. Meteorologiska iakttagelser i Sverige, Band 73. Pp. x+107. (Stockholm.) 7.00 kr.

Report of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the Year 1933. Pp. 12. (Cape of Good Hope: Royal Observatory.)

Comité International des Poids et Mesures. Procès-verbaux des séances. Série 2, Tome 15: Session de 1933. Pp. vii+215. Série 2, Tome 16: Annexes du Comité consultatif d'Électricité et de Photométrie, Mémoires présentés à la session de 1933. Pp. viii+342. (Paris: Gauthier-Villars.)

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnétisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 12. Pp. iii+92. (Paris: Les Presses universitaires de France.)

Travaux et mémoires du Bureau International des Poids et Mesures. Publiés sous les auspices du Comité International par le Directeur du Bureau. Tome 19. Pp. vi+74+127+54+97+48+7. (Paris: Gauthier-Villars.)

U.S. Department of Agriculture. Technical Bulletin No. 418: Transmission of Anaplasmosis by various Species of Ticks. By Charles W. Rees. Pp. 18. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 728: Surface Water Supply of the United States, 1932. Part 3: Ohio River Basin. Pp. x+370. (Washington, D.C.: Government Printing Office.) 20 cents.

Smithsonian Miscellaneous Collections. Vol. 91, No. 15: Reports on the Collections obtained by the First Johnson-Smithsonian Deep-Sea Expedition to the Puerto Rican Deep. Two New Congrid Eels and a New Flatfish. By Earl D. Reid. (Publications 3251.) Pp. 11+1 plate. (Washington, D.C.: Smithsonian Institution.)

Zoologica: Scientific Contributions to the New York Zoological Society. Vol. 17, No. 1: A Review of the Box Turtles. By Raymond L. Ditmars. Pp. 44. Vol. 18, No. 1: An Experimental Study of the Reproductive Habits and Life History of the Cichlid Fish, *Aequidens latifrons* (Steindachner.) By C. M. Breder, Jr. Pp. 42. (New York City.)

Cornell University: Agricultural Experiment Station. Bulletin 587: The Rural Churches of Allegany County. By William G. Mather, Jr. Pp. 32. Bulletin 588: History, Culture and Varieties of Summer-Flowering Phloxes. By A. M. S. Pridham. Pp. 32. Bulletin 591: Movement of Population to and from New York State. By W. A. Anderson. Pp. 36. Bulletin 595: The Rural Homes of City Workers and the Urban-Rural Migration. By Leland B. Tate. Pp. 54. Bulletin 599: Studies of the Effects of Handling Methods on the Quality of Market Peas. By F. S. Jamison. Pp. 28. Bulletin 603: An Investigation of the Cause of the Stiff-Lamb Disease. By John P. Willman, S. A. Asdell and Peter Olafson. Pp. 20. Memoir 153: Brand Canker of Rose, caused by *Coniothyrium wernsdorffiae* Laubert. By Cynthia Westcott. Pp. 39. (Ithaca, N.Y.)

Museums of the Brooklyn Institute of Arts and Sciences. Report upon the Condition and Progress of the Museums for the Year ending December 31, 1933. By William Henry Fox. Pp. 64+6 plates. (Brooklyn, N.Y.)

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Progressive Science and Social Problems

THE attention which is to be given at the Aberdeen meeting of the British Association to the relations between the advance of science and the life of the community may well make the meeting one of the most notable in its history. To a noteworthy degree the Association has adopted a policy urged upon it some thirty years ago by Sir Norman Lockyer, "to promote the application of scientific methods and results to social problems and public affairs".

This policy may be regarded as the direct outcome of the interest and discussion aroused by the presidential addresses and certain sectional addresses at the York and Leicester meetings. The programme indicates that the majority of the organising committees of the various sections have given very careful consideration to the memorandum placed before them by the Council suggesting that papers, discussions or symposia bearing upon the relations between the advance of science and the life of the community should be included.

Section A (Mathematical and Physical Sciences), for example, is arranging a discussion, to be opened by Mr. C. C. Paterson, on developments in photoelectric cells and their applications, as well as on the repercussion of such developments in the economic and general social life of the community. Even on the scientific side this discussion should meet a great need, for the *modus operandi* of the 'talking film', for example, is understood by comparatively few. The economic and social problems involved have scarcely received clear and critical formulation, nor are the potentialities of the photoelectric cell for the automatic control of processes or the prevention of nuisances anything like so widely grasped as is desirable by industry or by the community at large.

The discussions before Section B (Chemistry) on vitamin C, and on the chemistry of milk, may be relied upon to provide social and economic as well as scientific interest. Of wide general interest also is a full and varied programme arranged by Section F (Economic Science and Statistics). This includes an important discussion on economic planning which will be summed up by Sir Josiah Stamp; papers on risk and its significance in modern economy, statistical investigations into industrial fluctuations, economic anomalies of unemployment relief, and the

organisation of the Scottish fishing industry will deal with particular economic problems of great social importance. Equally significant discussions are being arranged by the Section through its Department of Industrial Co-operation ; Sir Josiah Stamp is to open a discussion on the need for a technique of economic change, while jointly with the Section L (Educational Science) an authoritative discussion has been arranged on the planning of a national policy of technical education and industrial recruitment. The presidential address to Section L will deal with the organisation of scientific work at the universities, while a session devoted to the development of post-primary education during the present century bears directly on the social and economic problems visualised in the Council's recommendations, and is closely related to the strictures recently passed on our educational system in regard to education for citizenship.

Much of the original impetus towards the consideration of the social consequences of scientific discoveries was derived from Section G (Engineering). The discussions on the reduction of noise, and Sir James Henderson's paper on the development of inventions as a stimulus to economic recovery, indicate no lack of interest in social implications in this Section, while Section E (Geography) can point to papers on the Aberdeen planning scheme and town planning generally, as well as to a specific discussion on the relations between scientific progress and social life. Papers to be presented before Section I (Physiology) on nutrition in relation to disease, and a symposium of food preservation, indicate the close concern of this Section with social problems ; with the discussion on nutrition, Section M (Agriculture) is also associated. The presidential address to the latter section deals with scientific progress and economic planning in relation to rural industry and country life. It will be followed by papers dealing with the planning of agricultural production, the diffusion of scientific knowledge to the farmer and with the sociological problems of the countryside. Cattle rearing and feeding problems will be considered at another discussion.

The presidential address to Section J (Psychology), "Psychology and Social Problems", is also concerned directly with the theme of the Council's recommendations, while the social significance of a discussion on psychological and child guidance clinics and papers on industrial fatigue, bilingualism, vocational guidance, or a sociologist's view of unemployment, equally attest the way in which the Section is seeking to focus attention on the social problems of the community.

The programme set before the Association at its Aberdeen meeting accordingly betokens a welcome assumption of scientific workers of their civic responsibilities, and indicates that an influential section of the scientific world is coming to think with intelligence and imaginative insight about social affairs. Though the indictment Sir Ernest Simon brought against both schools and universities in regard to education for citizenship is largely deserved, there are obviously honourable exceptions among the ranks of men of science themselves. The discussions before Section L (Educational Science) may, however, make some important contributions towards the realisation of Sir Arthur Salter's plea that a framework of elementary general knowledge added to specialised knowledge should be an indispensable condition for obtaining a university degree, particularly an honours degree.

The question of education is in fact fundamental in the consideration of the social aspects of science. It is not merely that the man of science must be capable of appreciating the non-technical social factors involved as well as the technical and scientific issues ; he must secure also the sympathy and understanding of the lay public. A real problem of to-day is that of enabling the common sense of the people to receive the best services of expert statesmen and administrators for the co-operative enterprise of reconstructing the forms of government to fit this scientific age.

The Aberdeen meeting of the British Association is indeed planned to reach that public to an extent not previously contemplated, and if the exposition of scientific and technical knowledge and methods is commensurate with the scope of the programme, some very valuable educational work may be done. The scientific world has to popularise, not merely or even chiefly, its proposals for the scientific control of civilisation, but also the knowledge and method from which those proposals derive their force. Unless we succeed in conveying to the man in the street such a broad understanding of scientific knowledge, there is real danger that a scientific programme may be regarded as the mark of yet another purely political party.

While under modern conditions science and politics can no more be kept apart without damage to the State than science and social questions,

science is entirely unfitted to figure in the programmes of any political party. Unquestionably, as the field of scientific inquiry is extended into social, economic and political questions, the results of such methods and inquiries may lead to conclusions and to policies or programmes for action which are contrary to existing party principles or prejudices. The task of securing action upon the facts is, however, scarcely one for scientific workers as such. It is their responsibility as individual private citizens to do all in their power to secure the appropriate action. They have, however, one further public responsibility which they cannot lightly evade. This is the task of awakening public opinion to the grave danger incurred in the neglect to take action along the lines indicated by the results of impartial and scientific inquiry. In this work the organised expression of scientific opinion through the British Association, the British Science Guild, the Association of Scientific Workers or other means yet to be determined should be of decisive influence, for it is essential to educate public opinion to the importance of the general principle rather than on a particular question in which vested interests may easily confuse the real issues. The organisation of scientific opinion in a way that would be quite irresistible is well within the bounds of possibility, given the requisite will and vision among scientific men themselves.

For such reasons as these, the Aberdeen meeting of the British Association may come to be regarded as a landmark. There is now much more general agreement that our forms of government are at a transition point and may require considerable modification if they are to meet our needs under modern conditions. However far functional change is carried in a democratic system, some means must be found by which the scientific and technical expert can take his part in the work of administration. The possibilities in this direction have already been indicated by the functioning of the expert committees of the League of Nations. On the other hand, it is vitally important that whatever system of government is developed should allow full freedom of growth and development in scientific and technical matters. To limit the field of scientific inquiry, to prescribe research, or to allow obsolete prejudices persistently to bar action in accordance with scientifically ascertained facts, is treason to the scientific spirit, and speedily results in its atrophy. It is in an atmosphere of freedom and not one of autocratic restrictions that the specialist can function in the way required. Above all, his contribution must not impose a further system of restriction or limitation on the general community. The closer association of science in the task of government is only possible on terms which admit of full and free discussion, of unfettered disinterested inquiry, of undiminished loyalty to truth and a vision characteristic of the great age of Greece.

For the scientific worker himself, he must be imbued with the ideal of service of the whole community, akin to the spirit in which scientific inquiry itself is undertaken. That spirit of service more than any other has prompted the scientific workers who meet in the British Association to inaugurate the many discussions to which we have referred. It has induced many of them to accept responsibilities of citizenship and of education from which they would willingly be free in order to pursue their scientific inquiries with greater energy. Their continuance in such tasks, their co-operation in the machinery of government to an ever increasing extent, cannot, however, be maintained on any sectional terms. Their help will be given in a spirit of wholehearted and unselfish service for the whole community as part of their allegiance to the supreme claims of truth, and no State which permits the wavering of that spirit or that allegiance can hope to withstand the pressure of modern conditions.

Matter and its Architecture

The Crystalline State. Edited by Sir William Bragg and Dr. W. L. Bragg. Vol. 1: *A General Survey.* By W. L. Bragg. Pp. xiv+352+32 plates. (London: G. Bell and Sons, Ltd., 1933.) 26*s.* net.

THE goal of chemistry is the determination of the atomic arrangement in space, which will be able to account for all the properties of matter under consideration. The greatest achievements in this direction have been obtained by the application of purely chemical methods, essentially because of the wonderful artistic skill of generations of chemists. Since von Laue's discovery of the diffraction of X-rays, and Sir William and W. L. Bragg's first X-ray analysis of the crystalline state, however, the way has been opened to a much more intimate knowledge of the atomic pattern. It is characteristic that the first results of the X-ray method dealt with the

stereochemistry of the solid state, which always had been nearly impossible to attack with previous methods. The X-ray method afterwards proved to be no less important for the structural analysis of liquids and of single molecules in the gaseous state, and this side of the development is by no means neglected in the first volume of the work before us; the title seems adequate because of the preponderant rôle the crystalline state has played in the great majority of investigations.

The first chapter gives an introduction to the general properties of the crystalline state. It furnished at the outset an opportunity to indicate how, with the introduction of the X-ray method, the centre of interest has changed. W. L. Bragg says: "In the past the study of the external crystalline form has been of the greatest importance, because it has been the principal means of identification and classification. The fundamental property of the crystal, however, is its atomic pattern and the external form is only one result of this pattern—a relatively unimportant feature, which depends in a complex way on external factors."

Having in this way centred the interest on the conception of a pattern based upon a space lattice, the second chapter is devoted to the diffraction caused by such a lattice. Here the author shows in a beautifully simple way how *three* conditions are required in order that the scattered waves may reinforce each other, and how two of these three conditions can be expressed as a reflection of the incident waves on any set of internal crystal planes, whereas the third leads to the famous Bragg-condition, between the angle of incidence, the distance of consecutive planes and the wave-length. The author underlines further that the pattern unit has no effect on the *positions* of the diffracted beams, whereas the configuration of the unit has, however, an important effect upon the *intensities* of the different spectra. Leaving the details of the interpretation of the intensities for a later chapter, the reader is sufficiently prepared for a discussion of the experimental methods. In the third chapter the Laue-method and its representation by suitable projections, the method of the ionisation spectrometer, the method of the rotation photograph, and the powder method, are treated; whichever one is to be employed depending on the form in which the crystalline material is available, whereas it is always of great advantage if more than one method is possible.

Everywhere in the book great care is taken to ensure that the reader does not feel lost in general considerations but remains in immediate contact with the actual facts. Thus the whole of the next chapter is devoted to the discussion of examples of crystal analysis. A few characteristic lattices are chosen (KCl, NaCl, ZnS, diamond, CaF_2, FeS_2), and step by step without effort the reader feels himself following a most agreeable guide.

The fifth chapter, on crystal symmetry, is the touchstone which shows the high skill of the author. Not that anyone doubts that W. L. Bragg possesses this particular aptitude, but in my opinion he has especially in this chapter excelled himself. After reading it I think nobody can possibly resist accepting his statement that "the complexities of crystal symmetry are more apparent than real".

The reader is next introduced to the principles of structure analysis. It is emphasised that it is always necessary to use a process of trial and error, and to the uninitiated it may appear at first sight as if complex structures could not successfully be dealt with. By many beautiful examples W. L. Bragg himself has amply shown that this is not so. Although as he says, "it is not possible to substitute the observed intensities in a formula which automatically yields the atomic parameters", no reasonable doubt is possible that in actual cases, notwithstanding the hundreds of parameters to be determined, correct atomic arrangements have been attained.

An investigator dealing with such questions should, of course, know as much as possible of the interplay of atomic forces in general, and of the arrangements which are preferred by the atoms. In the seventh chapter, the longest of the book, will be found the best opportunity to learn all that is desirable. The heteropolar bond, van der Waals' forces and atomic repulsion, the homopolar bond, the peculiar binding power of the hydrogen atoms, the metallic bond, the structure of alloys, the structure of organic compounds, the determination of the electron distribution in the molecules, are some of the topics. As in the same chapter Born's calculation of the energy of ionic lattices, and the explanation and calculation of the double refraction due to Silberstein's induction effect between the atoms, can be found, it is evident why this chapter had to be long.

Although it is true that ultimately the atomic arrangement in the pattern is of primary importance, it is not less true that many properties of

matter in the solid state are influenced by the size and orientation of the crystalline particles. So, what W. L. Bragg calls the 'geography' of the crystalline mass is also very important. Moreover, in this field much can be learnt by the X-ray method, and that is why a whole chapter, the eighth of the book, has been devoted to 'crystal texture'. It covers the field from the structure of liquids to that of cellulose fibres, wool and hair.

At this point, a first survey of the whole field being completed, the question of the structural analysis by waves in general is taken up a second time in Chap. ix on "X-ray Optics" and in Chap. xi on the "Diffraction of Electrons". Here the calculation of the scattering power of different atoms in its connexion with their electronic distribution, the use of Fourier series for the representation of the electronic distribution in crystals and for the interpretation of the reflected intensities, and last but not least, a treatment of the wave-properties of electron beams, are given. It is in connexion with accurate measurements of diffracted beams, so many of which we owe to Sir William Bragg and to W. L. Bragg themselves, that all these considerations become significant. By such a combination of a refined theory with experiments of high accuracy, we have already learnt a great deal more about the crystalline and the atomic structure, and we may confidently expect still more in the future.

A short summary of the application of X-ray methods to problems of pure and applied science in chap. X and a last chapter, xii, on the historical side of the subject make the volume complete in every respect. Six appendices on the production and properties of X-radiation, on the emission spectra and absorption edges, on absorption coefficients, on atomic scattering factors, on the deduction of the formulæ for the intensity of reflection and a table on the nomenclature of the space-groups will be of great use to everyone who is himself engaged in X-ray work.

The volume under review is intended to be complete in itself. It certainly is. Nevertheless, Sir William Bragg and W. L. Bragg intend to write a second and a third volume, in which the various branches will be developed in greater detail, with the collaboration of experts in the different parts of the subject. Once completed, the three volumes will be the most magnificent standard work produced for a long time, while the high note of the present volume can scarcely be surpassed.

P. Debye.

Studies in Comparative Religion

(1) *Pagan Survivals in Mohammedan Civilisation.* By Dr. E. Westermarck. Pp. viii+190. (London: Macmillan and Co., Ltd., 1933.) 8*s*. 6*d*. net.

(2) *High Gods in North America: Upton Lectures in Religion, Manchester College, Oxford, 1932.* By Prof. W. Schmidt. Pp. vii+149. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 7*s*. 6*d*. net.

(3) *East and West in Religion.* By S. Radhakrishnan. Pp. 146. (London: George Allen and Unwin, Ltd., 1933.) 4*s*. 6*d*. net.

(4) *Christian Myth and Ritual: a Historical Study.* By Prof. E. O. James. Pp. xv+345. (London: John Murray, 1933.) 12*s*. net.

(5) *A Short History of Religions.* By E. E. Kellett. Pp. 607. (London: Victor Gollancz, Ltd., 1933.) 5*s*. net.

IT is instructive to reflect that, of the five books grouped together here, all dealing with the history of religion, each employs a different method of attack. That a subject should permit of this variety of treatment in the study of cognate material, without in any one instance incurring justly the charge of superfluity or irrelevance, argues a degree of vitality that is exceptional in academic studies.

It is the more gratifying to note these signs of vitality, as recently there has appeared to be a flagging in the attention given to the comparative study of religions. 'Origin' and studies of the component elements of the Christian religion, such as that by Dr. James, have a constant appeal for a certain class of student; but the criticism that comparative studies have divorced their material from its context has had no little effect. Yet it is difficult to arrive at general laws—the aim of philosophic study—without some measure of abstraction.

On the other hand, the trend towards realism in anthropological studies demands more than an analysis of belief, however subtle, which hangs *in vacuo*. Hence the emphasis now laid on the study of ritual. The administrator, for example, may well ask what is the advantage of the study of a religion which has no apparent relation to conduct; for conduct in a specific environment, after all, is the matter with which he is immediately concerned. To this point of view, the reply is that even the study of Christian origins

is not without its practical bearing. The problem of the early Church was not dissimilar from that of an administration charged with the rule of a people living under tribal institutions. In the early Church, just as in the modern instance, a conflict of authority called for compromise. The Church, after setting its face against the practices of paganism, solved its problem by adopting such practices as were conformable to its usage to meet the needs of those of its members who, as citizens in secular life, still felt the need, or were bound to participate in communal ceremonial, just as under, let us say, the West African system of indirect rule, an adjustment is effected as between the rule of the administration and tribal custom in which a higher and a subordinated loyalty may co-exist.

(1) Prof. Westermarck's "Pagan Survivals in Mohammedan Civilisation" embodies the text of a course of lectures delivered in the University of London in 1931. The author describes a number of popular beliefs and practices of the Moslem world, taking Morocco as his starting point, and shows that in their present context they can only be regarded as survivals, like flies in amber, from a pre-Moslem phase of culture. Some of them are unquestionably of Arab origin, antedating the rise of Islam, while others are native to the respective countries into which the Moslem faith has been introduced.

For an analysis of this character, Morocco affords an excellent, if difficult, field; for while it is agreed that the Arabs who settled in the country were probably few and had little lasting effect on its culture, apart from its religion, the Berber himself is of mixed origin and from earliest times has been subjected to a succession of influences from ancient Egypt, Libya, Carthage, Rome and the north. How far these varied influences have affected the culture of the area may perhaps best be studied among the various survivals with which the author deals in the many forms and ramifications of the belief in the evil eye.

The lectures are close-packed with detailed information so skilfully handled as to hold the reader's attention from the first page to the last.

(2) Pater Schmidt's book also embodies the text of a course of lectures—a series on the Upton Foundation of Manchester College, Oxford, delivered in the autumn of 1932. Unlike Prof. Westermarck, whose study of survivals is based on direct observation in the field, the author is concerned with the analyses of material recorded by others, applying a theory and a particular method to a specific geographical area—North America. His lectures aim at showing that the religious systems of certain of the Indians of North America, classified in accordance with culture areas, imply the recognition of 'high gods', who are not otiose, but are creators, associated with the affairs of man, and objects of worship.

Without entering into a discussion here of the general theory of 'high gods', which the author has expounded fully elsewhere, it may be pointed out that in the instance of America, the view taken here of the primitive character of Amerindian belief, which is equated with the pygmy stage of human development in the Old World, demands a much earlier entry of man into America than either geologist, palæontologist or physical anthropologist is at present prepared to concede.

(3) In "East and West in Religion"—again a series of lectures delivered at Manchester College, with other discourses—the author's point of view is that the study of comparative religion, having advanced beyond the stage in which 'values' were in danger of being depreciated by the study of 'origins', its task is now the promotion of understanding on the basis that each religion has had, or still has, its contribution to make to human advancement. Hence he proceeds to show in these lectures how the West, having adopted an Eastern religion and adapted it to its needs, may still receive from the thought and religion of the East—here taken as essentially represented by India—some contribution towards the solution of ethical and religious problems of the day.

(4) In his study of Christian myth and ritual, Dr. James also is concerned with the analysis of a specific instance as an example of a type. The Christian religion is placed in an anthropological setting by a demonstration that certain elements in the precedent agricultural cults of ancient Egypt and Mesopotamia, the cult of the Divine King, have disintegrated and have been re-evaluated to take their place in the Christian cult, in which the central element is the death and resurrection of the deity, whence the pre-eminence of the Easter ceremonial over that of the Nativity in the early Church. Dr. James then proceeds to show how this concept of the divinity of the king, and the relation of his vigour to the prosperity of the country, is to be discerned in the whole ceremonial of the Church, coronation rites, ordination, marriage, burial and so forth, as well as in

popular customs and calendrical observances which have survived among the folk.

(5) The last book on our list requires little comment. It is an excellent historical survey of the main facts in the history of religions down to modern times, in which the treatment is impartial and objective. It is a marvel of compression.

Maps and Survey

Maps and Survey. By Arthur R. Hinks. Third edition. Pp. xiv+283+28 plates. (Cambridge: At the University Press, 1933.) 12*s*. 6*d*. net.

THE first edition of this work was published in 1913; subsequent editions, testifying to its popularity, have followed at intervals of ten years. It is not intended to be a textbook of surveying but "an explanatory introduction, unobscured by much detail, which shall exhibit the general nature of the operations, and the relations to one another of the various parts of the subject". In this respect we think it amply fulfils its object. The first seven chapters treat of maps viewed in their every aspect. Under the head of the history of early maps is collected, in a small space, an amount of information which could not be come by without reference to many original sources.

The modern map, on which no two people thoroughly agree, is fully dealt with. The various methods of representing topographical features are discussed in detail. Judging by the criticism one often hears, the public do not always appreciate the difficulties of the map designer. He has to produce something pleasing to the eye and at the same time a faithful, and easily understood, representation of the ground. This might not be difficult if the topography in each sheet were similar. But he has to deal with an infinite variety of ground covering the same series of maps, and of necessity must employ, if not the same at least a similar set of symbols, for it would be inconvenient to have the method of representation changing from sheet to sheet of the same series. In fact, as in many other things, compromise must largely enter into map design. British official maps and foreign maps, especially those of Europe, are treated in some detail, the chief features being commented on of the maps of each country.

The last six chapters are devoted to modern survey methods and instruments. Most of these are models of popular exposition of sometimes difficult subjects, while others, such as the chapter on the geometry of air photographs, may rather frighten the non-technical reader. Nevertheless, the ordinary reader who wishes to learn as much as possible about maps and how they are made cannot fail to have his interests immensely widened by one who is a master of the subject.

We recommend this book not only to the student of maps and survey, but also to the Colonial administrator. It would be to his own and his country's advantage if he were to study it, for it is "the truest economy to push forward the survey of a country at the earliest possible moment". This, however, is very often not recognised by those in administrative positions, who frequently display a lack of interest in maps and everything connected with them. The book contains a set of well selected illustrations. H. L. C.

Progress in Enzyme Chemistry

Ergebnisse der Enzymforschung. Herausgegeben von F. F. Nord und R. Weidenhagen. Band 3. Pp. xii+355. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1934.) 28 gold marks.

WORKERS in the domain of enzyme chemistry, the boundaries of which continue to enlarge, have begun to look forward to the appearance of the "Ergebnisse", with its neat summaries of particular branches of research, and we believe they will not be disappointed with this the third issue. As before, it is international, four of the articles being in English; they have been selected to cover sections which have not previously been summarised. It is proposed briefly to indicate the subjects chosen.

W. Frankenburger deals with enzyme reactions from the point of view of heterogeneous catalysis. Dean Burk of Washington discusses azotase, that enzyme system or complex in the aerobic soil organism that catalyses the change of gaseous nitrogen from a free to a fixed state. It differs from the majority of enzyme systems in that its activity is normally limited by the extent of growth, that is, by the amount of cell synthesis. Its nature has so far been investigated by means involving the methods of physical rather than organic chemistry, and as yet knowledge remains vague as to the stages during the conversion of nitrogen into protein.

Under the title of the action of enzymes in the living cell, A. Oparin of Moscow describes experiments dealing with the inactivation of enzymes on adsorption and their reactivation by elution;

perhaps a similar mechanism regulates enzyme activity in the cell. Of considerable interest is the article by G. A. van Klinkenberg of Oss on the specificity of diastase, which the Germans term amylase, developing Kuhn's striking discovery that there are two forms of this enzyme—one setting free α-maltose and the other yielding β-maltose from starch. This work has scarcely as yet received general recognition, though it is possibly the most important step forward of recent years in relation to the whole vexed question of the structure and hydrolysis of starch. The author considers in a summary that starch hydrolysis is brought about by two enzymes rather than by several: he emphasises the great variability in the physical character of different starch preparations.

There follows a lengthy account of the breakdown of starch and protein by the enzymes of malt by Albert Hesse, this being a well-studied industrial operation about which there is always something new being discovered.

The same applies to oxidation-reduction systems as catalysed by enzymes described by Hans von Euler, who comments among other things on the yellow flavine enzyme and vitamin B_2.

Robert Sonderhoff describes yet another yeast enzyme—the dehydrating system—whilst K. Bernhauer of Prague deals at somewhat greater length with the important oxidising fermentations caused by the lower organisms, particularly mould fungi and bacteria. Such reactions include the formation of gluconic acid, also acetic, fumaric, citric and oxalic acids, some of which are to-day technical manufacturing processes: in this field there is a fairly clear understanding of the course of events.

Phosphagen and its place in muscle biochemistry is described by P. Eggleton of Edinburgh, whilst there is a comprehensive article by H. A. Krebs from Cambridge on urea formation in the animal body, which gives a most useful summary of the urea synthesis from ammonia. The latter author emphasises the twofold significance of urea formation, namely, the conversion of the very poisonous ammonia into an extremely indifferent substance by a means avoiding the sacrifice of organic acids which, without urea synthesis, would be necessary to neutralise the ammonia formed in protein metabolism.

An article on catalase by Zeile is followed by one by F. J. W. Roughton on the newest of the enzymes, namely, carbonic anhydrase.

This volume contains a subject index to itself and to the two previous volumes. E. F. A.

Short Reviews

Extra-Sensory Perception. By J. B. Rhine. Pp. xiv+169+3 plates. (Boston, Mass.: Boston Society for Psychic Research, 1934.) n.p.

DR. RHINE has published in the volume before us the record of some 90,000 trials conducted at Duke University, North Carolina, in what the author terms "extra-sensory perception (E.S.P.)". The phenomena described by these words are substantially the same as those usually named in England 'clairvoyance' and 'telepathy'. The ability of the subjects is tested by the use of certain designs on cards, packs of the latter being 'called through' under various conditions (clairvoyance), or the design is merely imagined by the agent and thence transmitted (telepathy). The results of the guess are recorded in every case, and when subjected to mathematical analysis, are found to exclude entirely the chance factor as an explanation of the high scores obtained.

The object of the experiments was to answer the question as to the occurrence of E.S.P. by mathematically indisputable evidence, and also to gain some insight into the conditions of that occurrence. Dr. Rhine claims to have demonstrated the first conclusively and to have made some headway towards his second objective. He appears to have been fortunate in obtaining so many subjects who were able to demonstrate their remarkable gifts, although it is possible that other investigators have been more critical in their requirements, for Dr. Rhine, it would seem, was convinced of the reality of E.S.P. before he started his own experiments, mentioning such suspicious tests as those formerly given by the Creery Sisters as contributing to his conviction. Moreover, his own report is singularly lacking in those details which are vital to a proper understanding of his methods, as for example a full description of the cards employed and the means adopted thoroughly to shuffle them. A repetition of the experiments under much more stringent conditions would seem desirable, as it is clear that, if confirmed, the phenomena present problems of great interest and complexity.

The Flora of Iceland and the Færoes. By C. H. Ostenfeld and Johs. Gröntved. Pp. xxiv+196. (Copenhagen: Levin and Munksgaard; London: Williams and Norgate, Ltd., 1934.) 6*s*. net.

THE appearance of a modern flora of Iceland and the Færoes in English will be much appreciated by tourists and also by those botanists who are interested in boreal and arctic floras but cannot read Danish or Icelandic. The text follows Engler

and Prantl's system of classification and is of the descriptive key type, there being a general key to groups and families at the beginning. Many distinctive genera and even species are keyed out at this stage, a fact which may often save a great deal of the user's time. There are further keys to the species under each genus, providing a sufficient description of each species, together with information as to habitat, localities in each island group, time of flowering, etc.

The work includes much of the latest research on the floras of these regions. In addition, the authors have had the assistance of specialists in certain critical genera and this much enhances the value of the book. The chief criticism which may be made is that the international rules of nomenclature are not always adhered to, particularly in respect to hyphenated trivial names, while the taxonomy is sometimes rather out of date; for example, the treatment of *Habenaria*.

The format of the book is excellent, the printing good and the type judiciously selected. There are a few typographical errors, one of the most serious being *Agrostis cania* for *canina* on p. 20. A glossary, indexes to the popular names used in the two countries and two sketch maps add much to the usefulness of the book, which is of convenient pocket size. V. S. S.

La fécondation chez les animaux et chez les végétaux. Par Dr. Henri Coupin. (Actualités scientifiques et industrielles.) Pp. 203. (Paris: J.-B. Baillière et fils, 1934.) 22 francs.

DR. COUPIN has produced a descriptive account of gamete and zygote formation in the principal kinds of plants and animals, with 112 figures and an index of the names of the plants and animals cited. The matter is arranged according to a scheme explained in the introduction. The first division is made to depend upon whether the zygote is formed inside or outside the body of the organism. In each of these categories we have a series showing isogamy and one showing heterogamy. The further subdivisions depend upon the mobility or immobility of the gametes. So far as possible technical terms have been omitted. Subjects such as nest-building and special mating habits are treated to some extent under the various groups. The information given appears to be generally reliable, but the scheme of arrangement naturally leads to the various types of plants and animals being grouped in a somewhat unusual manner. One result of this is that cœlenterates are all considered as being forms in which the zygote is produced within the body of a parent animal.

The book can scarcely be described as one to be read through, but the main facts have been collected between one pair of covers as an extended summary of the subject, which should be useful to students, and for reference when not too much detail is required. Whether the matter in the form in which it is here presented will be of interest to those whom the author calls "les profanes éclairés" is more doubtful.

Allgemeine Konstitutionslehre in naturwissenschaftlicher und medizinischer Betrachtung. Von Prof. Dr. O. Naegeli. Zweite Auflage. Pp. vii+190. (Berlin: Julius Springer, 1934.) 16.20 gold marks.

IN recent years two general works have appeared dealing with human heredity from the genetical point of view, namely, that of Ruggles Gates, and the Baur-Fischer-Lenz volume which has been translated into English. Various other books have been written treating particular aspects of the subject or dealing in greater detail with limited fields.

Dr. Naegeli's treatment is from the constitutional viewpoint, yet he says little of Kretschmer but introduces a number of general biological discussions. A section of 26 pages discusses the conception of species, with illustrations mainly from botany, including several coloured figures of orchid varieties. The section on hybridisation also takes its material mainly from the plant world. The final 50 pages are devoted to a discussion of the relation between constitution and infectious diseases, including tuberculosis and various forms of anæmia. A classified list of human abnormalities is given with, for the most part, very little regarding the methods of their inheritance. The author appears to have been unable to make up his mind whether to write a book for medical men or for naturalists, but perhaps this will appeal especially to his Swiss fellow-countrymen in medicine who, it is well known, receive an exceptionally wide biological training.

A Garden in the Veld. By R. E. Boddam-Whetham. Pp. 290. (Wynberg: The Specialty Press of S.A. Ltd.; Ashford: L. Reeve and Co., Ltd., 1933.) 16*s*.

IN this book the author relates her experiences in laying out and cultivating—as a flower garden—the ground of the homestead of a newly acquired farm in the Orange Free State in South Africa. The writer admits that she commenced activities as a beginner with little knowledge of plants or gardening. The photographs bear testimony to the success that has been attained and to the skill she had obviously acquired as a cultivator under somewhat exacting conditions.

A special chapter is devoted to 'wild flowers', or the cultivation of ornamental indigenous species, but relatively few species are dealt with. Here the difficulty of successfully cultivating many of the wild plants is pointed out. It is regrettable that plants are sometimes referred to by common names only; for example, 'silver-lace', 'cotton-bush' (not *Gossypium*) with the result that readers outside the area cannot be expected to know what plant or type of plant is intended.

The book is written in a light or popular style and the notes and advice that the writer offers should be of interest and help to others, similarly situated in the 'high-veld' in South Africa, who are desirous of improving their gardens and surroundings.

Research and Road Traffic

By MERVYN O'GORMAN, C.B.

VARIOUS are the routes by which people attain the state of being 'firmly convinced' or 'absolutely sure': some will have been at pains to assimilate a sufficiently cogent proof, others will have got there by accepting idly what is called 'common knowledge', others more easily still by reiterating sufficiently an unproved but specious assertion. Politically, all these convinced persons are important—notably the last group—for reiteration is one of the instruments of politics. This group may be quite unaware of standing on weak ground but, on occasion, their subconscious recognition of futility is revealed by this token: that they are roused to a surprising anger by reasoned dissent, whereas the others can mostly entertain discussion, welcome a new viewpoint and derive pleasure from that valuable stimulus to thought—reasoned argument. The road traffic problem is one of multitudinous complexities but is so deceptively simple in appearance that assertions concerning its solution are rife, and strong convictions fortified only by 'it stands to reason' are almost universal. Everybody knows! This very universality would be convincing (such is another of the strange routes that lead us to our fixed judgments) were it not that a good few of us have a healthy suspicion of views upheld by imputing ill motives and supported by an indignation which, however well warranted at large, is directed with animus and without proof against some arbitrary mark.

It is into this matrix of somewhat unpromising public opinion that Sir Auckland Geddes, Dr. C. S. Myers and others—all too few—are instilling a self-questioning doubt so that, one day (the sooner the better!), a public demand must arise for such scientifically guided experiment and research as shall reveal the true prime causes of road traffic troubles—and substitute knowledge for guesses and emphasis. Dr. Myers and the staff of the National Institute of Industrial Psychology, as well as Sir Auckland Geddes, probably have their private theories, and even their prejudices, on road questions, but their minds are sharp enough to cut through the emotional fringe. They perceive (1) that they in fact do not know, (2) that no one else knows. Hence their desire that the Government shall be instructed to appoint disinterested persons to *find out* by the only known method—the scientific one.

The modes of appeal to the public of Sir Auckland Geddes and Dr. Myers are, however, widely different. Sir Auckland, knowing that his English audience have nice, kind and (ashamedly) sentimental hearts, warms them by a picture for their souls' awakening. He writes: "this morning, I saw a fair-haired infant turned out with a 'kiddy-car' to play on an arterial road along which lorries, omnibuses and cars were passing in endless streams". Appealing to gentlemen, he selects a blonde!—then he comes to business: "may we have an authoritative scientific inquiry to find out what we ought to do and avoid doing . . ." on one hand, for road safety and, on the other, for "the fullest possible development of the manifold uses of the internal combustion engine applied to Road Transport" (*Times*, July 7). He gave piquancy to his appeal, for he preceded the sentence quoted with the words: "Now that Parliament has almost finished its labours on this subject . . ." thus exposing the humour of thirty-three years of Parliamentary legislation in road matters, namely, preselecting the culprit, ordaining his punishment and then, perhaps, inquiring as to who might be responsible. In the circumstances he is right: better inquire late than not at all. It might turn out that the chief blame and responsibility for seven thousand deaths yearly on the road should fall on the triviality and ignorance of Parliament—albeit such home-truths—if true they be—should be stated very circumspectly by a wise committee of inquirers.

Having for years advocated this research, I observe that Sir Auckland Geddes' method of pleading is effective. I have had minor proofs. An appreciable number of persons have troubled to cut out his letter and post it to me! Some do so with approval, and one actually with anger—as at a transparent attempt to delay by research the pleasing institution of extra punishments and speed limits which 'stand to reason'.

In the journal of the National Institute of Industrial Psychology, the *Human Factor*, for July–August, Dr. C. S. Myers goes to work otherwise. He is not content with the mere advocacy of research. He does it. He leads by example. He has an organisation, and limiting himself to one subsection of the problem—the drivers—he has measured their speed of reaction, vision, vigilance, resistance to distraction, judgment of speed and size, etc. He and his staff do many of these tests in ingeniously simple ways, such that they cost little and can be applied to batches of eight persons. In this way, it appears, the time of the complete examination is shortened to about thirty minutes*. Having obtained groups of results and ascribed a tentative figure of merit to each man tested, he proceeds to standardise them, or rather to give to his laboratory observations a 'road user' value by comparing his figures of merit with those obtained from the records taken by the men's employers in relation to their previous and subsequent driving on the road.

It is good to hear that these selection tests have,

* The instrument by which a driver controls a dummy motor vehicle, while it appears to travel along a road, of which the image is projected on a cinema screen, is of wonderful ingenuity—but in my view, unless altered, this device is liable to mislead both examiner and examinee, especially whenever the latter is acutely responsive to the optical suggestion of an acceleration which fails to eventuate. In my own case I was made 'sea-sick' for some thirty-six hours after fifteen minutes of the test and therefore, feeling ill, I certainly drove below my form—which happens to include no road casualties in the last thirty years and only a trivial one in the six years preceding that.

on trial, proved to be economically remunerative to certain employers of road vehicles. "Thus in Paris," Dr. Myers says, "whereas the frequency of accidents caused by taxis, private cars and lorries *increased*, between the years 1923 and 1932, by 145 per cent., the accident frequency caused by the omnibuses and trams of the General Transport Company of Paris since their use of selection tests during the same period *decreased* by 30 per cent." Thus we have an instance of how research on one single element (and not the biggest element) in road traffic movement can save life and money.

This kind of verification is admirable. I trust that we may expect this class of testing to become habitual with employer companies. It will incidentally accumulate information of great value to governments.

Equally admirable is Dr. Myers' scientifically inspired restraint. We learn that he resisted the quick enthusiasm of a certain politician who was swept along too fast by zeal for this excellent work. Dr. Myers adhered to his conviction—born of knowing his job—that to make such a test compulsory on all applicants as a condition for obtaining a driver's licence should not be yet. It is one thing to use it for what it was designed, namely, selecting the safer men among a firm's practised drivers, and quite another to use it to bar persons for ever from acquiring driving experience on the basis of a test calibrated in terms of practised drivers. *Experto crede.*

No form of test so far enforced by any foreign government for the granting of driving licences, and none that has been advocated for Great Britain within my knowledge, deserve other than the fervent opposition of pedestrians as well as motorists. They can do nothing for safety—they do not discover the cause of the driver's faults—nor are his really bad habits likely to appear until the inspector has left and his supervision been forgotten. Examination in the Road Code is good and should be enforced on all road users, else obedience to it cannot be relied upon. (This is because all road safety has for its basis the possibility for each traffic unit to know in advance what the other unit is to be expected to do: not necessarily by hand signals, but by always obeying a known code of conduct.) Nevertheless, the line of research represented by the work of the National Institute of Industrial Psychology is bound to develop if given the encouragement it deserves, and to produce that foundation of knowledge on which a really valuable scheme for licensing tests could eventually be based. Holding such views and such expectations, I feel that the achievements and studies of the Institute warrant a much more generous recognition by the Minister than a pat and a cheap cliché. He said, "He would certainly watch the future of these experiments with much interest . . . !"

Instead of this detached and platonic watching, the Minister (who had just previously administered a *bonne bouche* of £5,000 to an organisation the function of which is to repeat 'take care' by poster and by preachment) should have given double this amount to an Institute which is doing the difficult thing: discovering '*how to take care*'! In return for the subsidy the Government would no doubt stipulate for access to the information that is being and would be increasingly accumulated.

Be it noted that our information on what constitutes 'taking care', on how to 'take care', on who should 'take care' and when, and on how to provide that people shall be imbued with the instinctive reaction to 'take care' in the right way on the roads, is practically nil.

Let us see what the psychologist—dealing with a totally different class of accidents—those relating to the breakage of crockery in restaurants—has to say about this 'take care' business (see *Human Factor*, July–August).

"Before the importance and the complex nature of this 'human factor' were adequately recognized, factory accidents were attributed mainly to culpable 'carelessness', foolish recklessness, and to dangerous machinery" (p. 267). "The average man . . . is disposed to ascribe breakages, like all other accidents, to 'carelessness', and hence to regard punishment . . . as the most appropriate measure for their reduction. But 'carelessness' has no precise psychological significance, and punishment is now recognized educationally as an inadequate and often ineffective remedy for defective conduct. To allege carelessness, as the cause of an accident, merely implies the fallacy that if sufficient trouble or attention had been given, the accident would not have occurred. Both punishment and the notion of carelessness are merely excuses for not inquiring into the ultimate causes of defective behaviour" (p. 269).

It is remarkable that each word of this quotation as well as the conclusion, albeit a general statement on a widely different subject, applies closely to road accidents, and is an unconscious plea for scientific research on road matters. Moreover, it falls in with Sir Auckland Geddes' plea. The national, economic and social interests that depend on the proper fostering of the industry of road transport and transit require that it shall have a research section of scientific men. It is abundantly clear that to be fruitful this reference to research must on no account be confined to accidents but must be directed to illuminate us on the fullest possible safe development of the manifold beneficial uses of road transport.

It may here be remarked that, in road questions, fatalities—not accidents—are commonly invoked, because in other contexts, for example, railway accidents, a Board of Trade decision provides that casualties are not to be counted until they reach a certain standard of seriousness (such as incapacitation from work for a prescribed number of days). On the other hand, road casualties are to be all reported (since 1930), whether significant or not, under severe penalties. Hence the complete break in the curves of casualty statistics in 1930—whereas the road fatalities give a curve. The introduction of the Road Code in 1930 (at the

same time as the removal of speed limits) reduced the total of fatalities so greatly that despite the increases of vehicles and the increase of exposure in two abnormally fine weather years, the peak of fatalities in 1930 has not yet been touched again.

The scientific method would assuredly require us to relate the number of road fatalities in a place to the amount of traffic flow (pedestrian and other) there. It would establish at an early moment the machinery for measuring and recording increments of safe traffic flow—and thus would enable us to determine to what extent each alteration of, say, police control, or pedestrian behaviour, or of road layout, etc., conduced to it. It would quickly determine for us the vehicular spacing and speed which would give to a bridge or tunnel its maximum safe carrying power. It would restrain a Minister who desired to say he had "no concern with the *accident ratio*, but only with accidents", for it would cause him to realise the fatuousness of such a remark. It could not fail to observe that a year having an abnormally large number of fine, dry summer days (such as had not been known for thirty-eight years previously) must give rise to a manifold increase of the amount of exposure (that is, vehicle, pedestrian and bicyclist hours on the road). It would not allow this to be dismissed as irrelevant when imputing to an increase of misconduct a three or five per cent increase of road deaths during such a year. It would measure instead of guessing the relative merits of 'traffic lights' and 'roundabouts' for road crossings, respectively in town and country. It would follow up the psychological work needed to evolve safe instincts in the pedestrian and driver. It would not permit misleading statistical statements as to causation of accidents to appear unqualified by the necessary scientific reservations. It would bring the noise nuisance within the range of things measured, and therefore make it controllable without imperilling the industry. Street and vehicle illumination, so far as it affects drivers and walkers, as well as the dazzle problem, would come within its purview, and so would the evaluation in terms of accidents and in terms of cost of non-skid roads, light-coloured road surfaces, proper sign-posting, and street naming—to give only a few examples.

A scientific inquiry would, in addition, lead us to the study of: the effect of alcohol or fatigue on the rapidity of drivers' and pedestrians' reactions, and the amount of slowing of reactions which may be significant. The true distribution of responsibility for causing vibration as between vehicle and road construction. The effect on road wear of various speeds—and of various weights—and of various intensities of pressure at the tyre. The economic advantages, or the reverse, of dispositions of traffic which are to-day left to speculation, the effect of trailers or, say, the values to be got from statistical knowledge of the average vehicle's circular journey in a town. The balance sheet of advantages, safety or road economy obtainable from providing for or prohibiting the *standing* of vehicles. There is no end to the list, for I realise as I am sketching out the services that a research committee could render that a full list would be tantamount to a statement of the essential knowledge which hitherto governments have neglected to obtain. In many instances they have even neglected to seek it.

In England, where, of the sixty-four millions sterling contributed by motorists alone, two thirds are taken away from the service of the road users' urgent needs, there is no warranty whatever for continuing on a course of parsimony which denies us the support of science and is paid for in the flesh and blood of the road users.

Interactions of Gases and Ores during Iron Smelting

FOR some years past, under the auspices of the National Federation of Iron and Steel Manufacturers (now the British Iron and Steel Federation), an experimental inquiry has been carried out at the Imperial College of Science and Technology, London, under the direction of Prof. W. A. Bone, into the interactions of gases and ores during blast-furnace iron smelting. The results of this investigation have been embodied in a series of communications to the Iron and Steel Institute in 1927, 1930 and papers read at its meeting in London on May 31 last. The latest report (Part 4) is of special interest in that it deals comprehensively with (1) equilibria in the systems $Fe_xO_y+yCO \rightleftharpoons Fe_xO_{y-1}+yCO_2$ between 750° and 1150° C., and $Fe_xO_y+yH_2 \rightleftharpoons Fe_xO_{y-1}+yH_2O$ between 450° and 850°; and (2) the relative velocities of ore reduction by the carbonic oxide in blast-furnace gas over a temperature range of 450°–1,000° under the same conditions as regards gas speeds and composition as are met with in the blast-furnace itself.

While equilibria constants in the reversible reactions referred to are independent of the speed of the gas-stream involved, it has been found otherwise with both the absolute and relative velocities of ore reduction at a given temperature. One of the difficulties of the laboratory investigation has been the accurate determination of such velocities under the conditions of high gas speeds (up to 50 ft. per sec.) actually prevailing in blast-furnaces. This difficulty was, however, successfully surmounted, and the subsequent ore reduction velocity measurements were carried out at each of five selected temperatures (450°, 650°, 750°, 850° and 1000° C.) and in each case at each of three gas speeds (4, 16 and 48 ft. per sec.)—corresponding with slow, medium and fast rates of driving in the blast-furnace—in such a manner as enabled relative velocities to be determined precisely under these conditions, not only throughout the whole range of ore deoxidation up to 90 per cent completion, but also for every CO_2-content of the blast-furnace

gas up to the CO/CO_2 equilibrium ratio at the particular temperature involved. Such conditions comprise all that are likely to be met with (as regards ore reduction) in the blast-furnace between the temperature limits referred to.

The results obtained show, *inter alia*, that (as might be expected) at each temperature the velocity of ore reduction diminishes progressively as the reduction proceeds and the carbon dioxide content of the gases increases. Such rate of decrease is not, however, uniform with the state of deoxidation of the ore, being generally smallest when the ore is about half reduced. While an increase in the gas velocity from 4 ft. to 16 ft. per second invariably resulted in an increase in the relative reduction velocity at all the temperatures investigated, a further increase in the gas speed to 48 ft. per second reduced the ore reduction velocity at 650° but increased it at 850°.

The results have also shown conclusively that there are three definite stages in the ore reduction, corresponding with the three known oxides of iron, namely, Fe_2O_3, Fe_3O_4 and FeO.

The main interest of the research lies, however, in the discovery that, as regards the third stage (that is, FeO → Fe)—which comprises two thirds of the whole deoxidation—the rate of ore reduction for corresponding speeds and compositions of the gas throughout the range 650°–1000° C. in the furnace is at a decided minimum between 750° and 800°–850° C. This applies to all the three gas speeds examined, and points to there being a change in the mechanism of ore reduction by carbonic oxide round about 750°. Thus, the relative velocities at 50 per cent ore reduction, for each of the three gas speeds in question, varied as in the accompanying table with the temperature

Relative Ore Reduction Velocities by Blast Furnace Gas
(in terms of units of oxygen removed per unit time)

Temp. °C.	650			750			850			1,000		
Gas velocity ft. per sec.	4	16	48	4	16	48	4	16	48	4	16	48
Percentage CO_2 in the Gas 2·5	3·2	3·5	1·75	1·2	1·4	1·05	1·85	2·0	4·55	11·8	13·5	12·0
Percentage CO_2 in the Gas 5·0	2·1	2·6	1·15	0·9	0·95	0·7	1·1	1·3	4·2	7·0	11·1	7·4

and CO_2-content of a 'blast-furnace gas' originally containing 33·4 per cent of carbonic oxide and 66·6 per cent of nitrogen (that is, $CO+2N_2$).

This last-named discovery would seem to be of great importance to blast-furnace practice, especially as 750° is the temperature at which the strongly endothermic decomposition of any limestone ($CaCO_3 = CaO + CO_2 - 42{\cdot}5$ k. cal.) in the burden presumably would be beginning to affect the furnace conditions, and therefore the 750°–850° zone may be of considerable extent in the furnace. Moreover, since the research has also shown it to be that in which ore reduction by any impregnated carbon becomes vigorous, its precise location in the furnace would now seem to be an important matter. Indeed it is clear that if the industry is to reap full benefit from the research, a systematic exploration of the temperature, composition of gas, and ore reduction conditions in blast-furnaces smelting typical ores has now become imperative.

This consideration has so strongly forced itself upon the British Iron and Steel Federation that some months ago a sub-committee was set up, with Prof. Bone as chairman, to consider whether (and if so, what) steps can be taken with a view of organising, and afterwards carrying out, systematic investigations on some typical British blast-furnace plants, and to correlate the results so obtained with those of the laboratory research since its inception.

The sub-committee, having completed its preliminary survey of the matter, has unanimously reported that such an investigation on typical blast-furnace plants is both practicable and highly desirable. Also, certain blast-furnace proprietors and managers who have been approached on the subject have expressed their approval of, and willingness to co-operate actively in, the project, and an experimental trial carried out in December last on a blast-furnace at Park Gate Works, Rotherham, by Mr. F. Clements and his staff, has proved its practicability. So that not only does the time seem ripe, but also the atmosphere is favourable, for putting it into operation, and steps are being taken accordingly. Thus there is now every prospect that the work on the chemical phenomena of iron-smelting, begun by Lowthian Bell sixty-five years ago, may be carried to completion in the country of its origin.

Obituary

MR. H. GLAUERT, F.R.S.

SCIENCE and aeronautics have suffered a severe loss through the fatal accident to Mr. Hermann Glauert on August 4. Mr. Glauert was walking with his brother and his three children, and stopped to watch the blowing-up of a tree-stump; a large piece of wood, projected nearly 100 yards, struck and killed him instantly.

Born in Sheffield on October 2, 1892, Mr. Glauert was educated at King Edward VII School and Trinity College, Cambridge. He was a Wrangler with distinction in the Mathematical Tripos in 1913: was awarded the Tyson Medal for 'astronomy and related subjects', the Isaac Newton studentship in 'astronomy and physical optics' (1914), and the Rayleigh Prize for mathematics (1915). He joined the staff of the Royal Aircraft Factory at Farnborough in 1916. In

1920 he was elected a fellow of Trinity, continuing to work at Farnborough. He was a fellow of the Royal Aeronautical Society and he was elected a fellow of the Royal Society in 1931. He married, in 1922, Muriel Barker, a Newnham mathematician and one-time colleague at Farnborough: he leaves two sons and one daughter. He had been for some time a principal scientific officer, and last April he succeeded the retiring head of the Aerodynamics Department of the Royal Aircraft Establishment. He had achieved a world-wide reputation in aerodynamical circles.

Glauert combined, with great mathematical knowledge and ability, a fine physical insight and a talent for approximation, which fitted him peculiarly to satisfy the needs of the aeronautical engineer. His knowledge of German, in addition, placed him in a position to follow the work of the German aerodynamical school. The pioneer work of Mr. F. W. Lanchester, given to the world in his "Aerodynamics" in 1908, received too scant attention in Great Britain, but it inspired Dr. Ludwig Prandtl of Göttingen. The work of Dr. Prandtl and his students spread throughout the world after the War. Glauert was quick to appreciate its value and to introduce it to English readers through his translations.

Glauert concentrated mainly on this line of study and made many original contributions to the theory of aerofoils. Perhaps the most important was a rational theory of the airscrew, which adequately fitted experimental observations and provided a sound basis for practical design and for further study. When the autogiro appeared he successfully turned his attention to an aerodynamic analysis. He also followed up the work of Joukowski and Kutta in deriving the flow round an aerofoil by conformal transformation, extending the method to sections with a finite angle at the trailing edge and originating the later series of R.A.F. sections. He deduced the effect of compressibility of the air on the performance of an aerofoil while streamline motion persists.

Glauert's papers published by the Aeronautical Research Committee were numerous, and he contributed also to the *Proceedings of the Royal Society*. His textbook, "The Elements of Aerofoil and Airscrew Theory" (1926), met a real need and has been widely used; he was awarded a medal for it by the Aero Club de France. More recently, he contributed a part to a more ambitious work undertaken by the Guggenheim Fund under the editorship of Prof. W. F. Durand, of Stanford University. But the full measure of his influence is not to be found in his published papers alone: he was a constant guide and source of inspiration to his colleagues, and he had given enough proof of administrative ability to show that he would make a good head of a research department.

Glauert's habits were tidy, punctual, systematic: his style clear and concise. A rapid worker with great power of concentration, he could turn his mind aside and was ever ready to discuss any subject, a quick and tenacious debater; but he was always loath to deal seriously with problems in any branch of which he did not feel himself master. Outside his work he mixed freely and joined with zest in games and social activities. He will be keenly missed by his associates both at work and at play.

PROF. W. C. CLINTON

WE regret to record the decease of Prof. Wellesley Curram Clinton, who succeeded Sir Ambrose Fleming as Pender professor of electrical engineering in University College, London, in 1926. He had been prevented for the last three months from attending to his University work by illness, which was not considered to be serious at first, but in August it took an unfavourable turn and to the grief of his relatives, friends and colleagues, he died on August 18. He was sixty-three years of age, having been born in London on October 28, 1871, and he received his early scientific education at Finsbury Technical College under Profs. Ayrton and Perry.

Prof. Clinton had been officially connected with University College for forty-one years. He went as assistant to Prof. Fleming in 1893, when the present Engineering Laboratories were opened, and was appointed successively demonstrator in 1894, assistant professor in 1906, sub-dean of the Faculty in 1919 and Dean in 1934, but did not live to take up that last office. He was elected a fellow of the College in 1920 and fellow of the City and Guilds of London Institute in 1933. He was elected a member of the Institution of Electrical Engineers of London in 1912.

From 1893 until 1926 Clinton assisted Sir Ambrose Fleming in the work of the Electrical Engineering Department of University College with the greatest efficiency and devotion to his duties, and a large number of those now eminent in the electrical engineering profession were his students and will remember with great affection his effective teaching and kindly help. His amiable disposition and efficiency in work made him extremely beloved and appreciated, and his loss will be deeply felt as he was to the front in all that concerned the welfare of the College.

In addition to his College work Clinton found time for some scientific research. He made a speciality of photometry. He translated into English a book on that subject by Dr. L. Bloch, and he published a very useful book on "Electric Wiring" in 1902. He was a contributor to a work on "Modern Electrical Engineering" edited by Sir Magnus MacLean. He also wrote papers on the voltage ratios of the inverted-rotary converter (*Proc. Phys. Soc. Lond.*, 1906), on the efficiency of direct current machines by the Hopkinson method, on a comparison of estimated and observed values of illumination in some lighting installations and on some photometric tests of brightness of radioactive materials. He could have done more research work were it not for his entire devotion to his College duties.

News and Views

Traffic Noise and the Ministry of Transport

THERE is evidence that Great Britain is becoming noise conscious; and we have had occasion during the last few years to refer to the subject of noise measurement and noise control as conducted at the National Physical Laboratory and elsewhere. Certain directions in which traffic noise might well receive the attention of the Government were put before the Anti-Noise League at its recent meeting at Oxford (see NATURE of July 28, p. 149). As from August 27, the Minister of Transport has now decreed a zone of silence for the London area, the hooting of horns being entirely prohibited at night (between 11.30 p.m. and 7 a.m.) within a radius of five miles from King Charles's statue at Charing Cross. London Transport is also instructing its tram drivers not to use gongs in the prescribed area. To judge by the experience of Paris, Brussels and Rome, where no increase in road accidents is reported as the result of similar measures, the experiment is likely to be wholly successful, and relief from, at any rate, one type of noise will be experienced by the area in question. It is understood that similar zones of silence will be set up in other parts of the country.

THE Minister has also set up a new Committee to deal with traffic noises in general, the terms of reference being "to consider and report upon the principal causes of noise in the operation of mechanically-propelled vehicles and the steps which can efficiently be taken to limit the noise so arising". The members of the Committee are: Sir Henry Fowler (chairman), formerly chief mechanical engineer of the London, Midland and Scottish Railway; Mr. Leslie Walton, deputy president of the Society of Motor Manufacturers and Traders; Mr. H. R. Watling, director of the British Cycle and Motor-Cycle Manufacturers' and Traders' Union; Dr. H. J. Gough, superintendent of the Engineering Department, National Physical Laboratory; Dr. G. W. C. Kaye, superintendent of the Physics Department, National Physical Laboratory; Mr. E. S. Perrin, Ministry of Transport; Mr. A. E. N. Taylor (secretary), Ministry of Transport. It is believed that the exhaust silencing of sports cars and motor-cycles, the chief noise offenders on the road to-day, will receive special attention. The Government will place at the disposal of the Committee the full resources of the National Physical Laboratory, where new acoustic laboratories (described in NATURE of August 11, p. 202) were recently completed. Work on the exhaust silencing of motor-vehicles has also been carried out at University College, Southampton. Such questions as the setting up of standards of noise as the basis of legal control, if that should be considered desirable, will clearly have to rest on scientific investigation, but it is evident from the composition of the Committee that the Minister seeks the co-operation of the industry in giving practical and equitable effect to the findings of the Committee in its efforts to secure quieter road transport.

Science and War

THE issue for August of the *Labour Monthly* includes replies to a questionnaire addressed to various people, labour leaders, sympathetic professors and others, on the subject of war. The purpose, of registering strong labour opposition against war, is of course an excellent one, but this presentation of it is unfortunately marred by the intemperance of the language and the obvious intention of linking up any war that might occur, with the continuance of what the editors describe as the "present capitalist and imperialist system". No evidence is offered of the assumed connexion between the two, and any worker who at the call of his country would again consent to fight, is dismissed as a slave of imperialism. The whole great subject of war, especially in relation to science and the future of society, is of intense interest, but one must regret the use of it as a stick to beat our own suffering society, and that of other countries, especially France and the United States, which are obviously intensely and nationally pacifist. No fair-minded person can imagine that our Government or any other Government which we are at all likely to have, would wish for war or do otherwise than make every possible effort to avoid it. Governments may very possibly make mistakes, or miss chances of doing something which might promote a better general spirit. For this they should be watched and criticised, but if, for purposes of another propaganda, we assume that they are dishonest or subservient to unworthy interests, the unfairness of the charge tends to create another division among the naturally pacific forces of the country.

BY such means we run a risk of strengthening the very influences which we are most anxious to suppress. Thus the League of Nations is obviously a force for peace. It is not at the moment so strong as the friends of peace would desire, and has certainly missed some important opportunities in recent years. But when Mr. C. H. Norman (quoted in this pamphlet) says, "I noticed that over fifty of them [delegates to a League of Nations Conference] had committed crimes varying from murder, blackmail, sodomy, offences against children, down to all the swindling and fraud that is the second suit of most European and American politicians", the candid reader will shake his head in despair. Indiscriminate mud-slinging can have no result but an occasional murder. The analysis of the social forces at work on such occasions as the outbreak of a great war is as puerile as the tone is spiteful. The same remark would apply to the judgment of Mr. Ernest Henri, also given in the pamphlet, that "the Nazi movement has failed in Germany". That it has great elements of weakness, and that it might end in a grave social upheaval, may well be sustained, but that it "has failed" is so foolish a judgment that it can only spring from a mind determined to see nothing but what it wants to see. Unfortunately, this is the

stamp of all thinking and writing of this character. It is the exact opposite of the scientific frame of mind, and makes one think that the spread of science and the scientific spirit into all realms of thought is one of the two supreme needs of the age.

Inauguration of the Mettur Dam and Reservoir

THE development of irrigation in India has taken another notable step forward with the recent completion of the Mettur Dam in the province of Madras, and the occasion of the official opening on August 21 was marked by an impressive ceremony when Sir George Stanley, the Governor of Madras, made the electrical contact which operated the sluice penstocks and released a huge volume of water from the impounded area. The dam and reservoir, which are to take the designation "Stanley", are located on the Cauvery River, 100 miles north-west of Trichinopoly and 180 miles south-west of Madras. The dam, one of the most massive structures of its kind in the world, contains 1,852,000 cubic yards of masonry weighing 3,200,000 tons; it has an over-all length of 5,300 ft., and a height of 176 ft. The reservoir will extend more than 40 miles north of the river, with a circumference of about 100 miles, and will have a capacity of 90,000,000,000 cub. ft. The catchment area is 15,700 square miles in extent and the total area to be irrigated will be rather more than 1,300,000 acres, including some 300,000 acres at present without any form of irrigation. Pipes have been built into the dam to permit of the utilisation of some of the water for the generation of hydro-electric power in a scheme which is now under consideration by the Secretary of State. The cost of the Cauvery-Mettur undertaking is given as about 5½ million sterling. The idea was conceived about a century ago by Sir Arthur Cotton, but work was not begun until 1925 and benefited by the experience gained during the unprecedented floods of the previous year, which caused a revision and extension of the scheme. For his services in connexion with the work, Mr. Clement T. Mullings, who was chief engineer of the project from 1927 until 1931, has received the honour of knighthood.

Chronology of Scottish Caves

AN examination of the contents of a large cave at Southend, Kintyre, Argyllshire, by Mr. Hamilton Maxwell, on behalf of the Glasgow Archæological Society, has yielded in the course of digging through 10 ft. of deposit down to bed-rock a number of relics in bone, horn, bronze and iron, mostly belonging to the early iron age. According to a report in the *Times* of August 28, the object of the investigation was to ascertain the probable date of the erosion of the cave; and for this the date of about 4400 B.C. is now suggested. This conclusion is based upon a comparison with the Oban caves of Azilian date and the butt sites at Oronsay, explored by Messrs. Henderson, Bishop and Ludovic McL. Mann. The Oban caves have been taken as dating from about 13000 B.C. This gives, therefore, a dating for the Scottish levels of a raised beach at 27½ ft., 13000 B.C.; a sunken beach at a depth of 20 ft., about 8700 B.C.; a raised beach at 9½ ft., about 4400 B.C.; and a sunken beach at a depth of about 7 ft. at about 100 B.C.

Meare Lake Village

EXCAVATIONS were resumed on the site of the Meare Lake Village on August 20 and will continue until September 8, or longer, should funds permit. The investigation is being carried on, as usual, under the auspices of the Somersetshire Archæological and Natural History Society, Dr. A. Bulleid and Mr. St. George Gray again being the field directors. The season's work will be directed to the exploration of two areas in the middle of the group of dwellings of the eastern half of the village. The first of these is a confused area of hummocks and hollows, of which the significance is not clear from surface indications. Apparently the mounds overlap and have been much mutilated superficially. The area is surrounded by a rough lias-stone wall, slight in height, of some 70 ft. in diameter. In a report on the work of the first week which appears in the *Times* of August 28, it is stated two clay floors of dwellings have been found under the stones. On the upper floor was one of the most ornate and best preserved weaving-combs of antler as yet found in the lake village remains. The second site under investigation is a dwelling mound of approximately 35 ft. diameter, which apparently has three floors, the uppermost being paved with small lias-stones. At this level, two much-defaced brass Roman coins of the fourth century were found. At lower levels, pre-Roman objects included pottery with 'late-Celtic' ornament, bronze finger-rings and a buckle and a brooch of La Tène III type. A clear glass bead with yellow spirals was found below the floors. Among the animal remains were bones of two beavers, traces of which are rarely found in Great Britain.

Excavations in Berkshire

FURTHER particulars of the excavations on the Berkshire Downs to which reference was made in NATURE of August 18, p. 244, have been received from Mr. H. J. E. Peake. The site on which was discovered the skeleton of a dog was a round barrow on East Lockinge Down, which is mentioned in the bounds of Lakinge in a charter of A.D. 868. The remains were in the upper and larger of two holes in the chalk near the intersection of trenches dug across the barrow with the object of discovering the ditch, which was not visible on the surface. It was found that the highest point of the barrow is not in the centre. A small hole at the central point, about a foot in diameter, contained burnt human remains, but no grave furniture. The date suggested is the end of the Early Bronze or beginning of the Middle Bronze Age. The irregular round barrow in the parish of East Hendred, from which the remains of the two horses were obtained, was found to have no ditch. Beneath the skeletons of the horses were a number of small objects of Roman date, including fragments of an iron knife and the pin of a bronze

fibula hinged to a La Tène coil. Elsewhere in the barrow were numerous fragments of Romano-British pottery and a small bronze hook. The exploration of Cuckhamsley, or Scutchermer Knob, which is known to have been rifled about a hundred years ago, provided no evidence of burial; but a number of fragments of pottery, including finger-tip ware, consistent with a fifth century B.C. dating were turned up, while 2 ft. above were potsherds and a fragment of copper or bronze of foliated design. The mound is evidently not a bronze age barrow nor the burial place of a Saxon king; what the purpose of this remarkable construction may have been has not been revealed.

Quaternary Research in Ireland

EARLY in 1933 a committee entitled "The Committee for Quaternary Research in Ireland" was founded under the chairmanship of Dr. R. Lloyd Praeger, with Prof. H. J. Seymour as treasurer and Mr. A. Farrington as secretary, the personnel of the Committee being representative of all the scientific bodies and universities of Ireland. The Committee succeeded in enlisting the support of Irish scientific societies, the universities and the Free State Government. The object of the research is to establish a chronology for late-glacial and post-glacial deposits in Ireland, and to study the history of the Irish flora and fauna. Prof. K. Jessen of Copenhagen, with his assistant Mr. H. Jonassen, was invited to take charge of the research. One of the most important aspects of the scheme as conceived by the Committee is the training of Irish students from the universities in the methods developed in northern Europe, so that research centres may be permanently established in the country. Work was begun in the present summer, the first site to be examined being the well-known bog at Ballybetagh in south Co. Dublin where many remains of *Megaceros Giganteus* have been found during the last hundred years. An extended tour will also be made for the examination of deposits in many other districts throughout Ireland. A list of well-dated recent archæological finds from peat bogs, compiled by Dr. A. Mahr, Director, National Museum, Dublin, forms the basis of this tour.

Expeditions of the Smithsonian Institution, 1933

OWING to the period, variable in duration, but usually not inconsiderable, which must elapse before it is possible to publish in full the details of the valuable field-work which is carried out by the Smithsonian Institution in astrophysics, geology, biology and anthropology, the annual exploration pamphlet issued by the Institution is of considerable interest, as giving an early authoritative account of the various expeditions sent out during the year. The latest issue (Publication 3235), for example, which covers the activities of 1933, records the establishment of a new solar observing station on Mount St. Catherine, Sinai (G. C. Abbott), and describes the work of the Norcross-Bartlett Arctic Expedition (Capt. R. A. Bartlett), of a deep-sea expedition to Puerto-Rico (Paul Bartsch), a search for extinct marine mammals in Maryland (Remington Kellogg), particulars of the Hancock expedition to Galapagos (Waldo L. Schmidt), and zoological collecting in Siam (Hugh M. Smith). The greater part of the publication, however, is devoted to the activities of members of the Smithsonian staff in the investigation of the archæology and ethnology of the American Indian, the former a subject in which great progress has been made in recent years by the systematic application of scientific methods of excavation and correlation of results. Dr. Frank H. Roberts, Jr., has continued his excavations of Pueblo sites in the south-western United States, in which the development of Pueblo culture and more particularly of the Pueblo dwelling is being revealed. Dr. Walter Hough has also been engaged in studying an important aspect of Pueblo culture by tracing ancient canals in Arizona, while an earlier phase of Indian history has been illuminated by Mr. F. Setzler's cave and mound explorations in Texas and Louisiana. Dr. W. D. Strong has been engaged in the study of the archæology of Honduras and the Bay islands; while Miss Frances Densmore in her studies of Floridan music and Mr. John Harrington by oral inquiry among ancient members of Californian tribes have recorded material which, but for their activities, would shortly have been lost beyond recovery.

Electrification of the Suburban Railways of Copenhagen

THE population of Copenhagen and its suburbs is about 800,000 and they are served by a number of railways, the most important belonging to the State Railway. The problem of electrification presented special difficulties as Denmark is dependent on imported coal for its electric power supply. During recent years, an appreciable amount of electric power has been transmitted from Sweden by 25,000 volt cables which pass under the Sound. When the problem of supply was first investigated, the choice narrowed down to 3,000 volts or 1,500 volts direct current. The latter was chosen, as, although the cost of the overhead equipment was greater, the cost of equipping the cars was less. Hence, when in the future the number of cars is increased, the cost will be less. An account of the system is given by J. Kristensen in the *Electrical Times* of August 23. He says that all the lattice masts are galvanised, as although it is more expensive than painting it is far more durable. Electrically, the whole system is divided into sections connected through line disconnecting switches. To prevent the electrolysis of neighbouring pipes, extensive precautions are taken. The use of stone ballast keeps the resistance between rail and earth very high, and the resistance of the return system is made as small as possible by joints of heavy copper wire electrically welded to the rails. To prevent interference with telegraph and telephone wires, these have been effectively insulated and placed as far away from the rails as possible. The smallest train is called a 'half-train' and is made up of two motor coaches with a 'trailer' between. It has a seating capacity of 250, and standing room for 200 more. The line Frederiksborg-Klampenborg was opened in April, and the line Copenhagen-Hellerup in May.

Elinvar Hairsprings in Watches

R. E. GOULD has recently published a paper on the comparative performance of watches with the usual cut bimetallic balance wheels and steel hairsprings, and those of the new form having uncut monometallic balance wheels and elinvar hairsprings (*Bureau of Standards J. Res.*, 12, April 1934). Elinvar is a nickel-steel alloy having a temperature coefficient of elasticity which is practically zero from 5° to 35° C. (41° to 95° F.). In the new watches the balance wheel is non-magnetic. The experiments show that the temperature-rate errors of the watches having the new vibrating assembly were smaller than the errors with ordinary watches. Instead of the usual parabolic curve of errors a curve approaching a straight line was obtained. The use of the new assembly ensures a very marked improvement in the performance of the watches. The new arrangement almost entirely overcomes the effects of magnetism, so that after a watch has been subjected to a strong magnetic field the rate is not affected. Very few watches maintain an absolutely uniform rate as the mainspring unwinds. If the number of seconds lost or gained since winding be plotted against time after winding, true 'isochronism' is represented by a straight line. So far as 'isochronism' goes, the new assembly does not give any material advantage over the old. Also various small changes, caused by altering the positions of the watches, are practically the same in both types.

Thames Estuary Fisheries

MR. LAURENCE WELLS, who has from time to time contributed articles to the Southend newspapers based on the notes of the late Mr. James Murie, has recently published two more, the "Whitebait Industry" and the "Spratting Industry" (*Southend Pictorial Telegraph*, April 14 and May 24, 1934). Nearly two hundred years have passed since whitebait was first fished for, and the industry was much more important a hundred years ago than it is to-day. There are, however, signs of revival in the trade, and now there are more whitebait in the river than the merchants can dispose of, although one hundred and fifty years ago it was prophesied that within ten years the river would be denuded of fry. Sprat-fishing is apparently on the decline, and the only salvation for the Thames spratters is the canning industry which is here described. Mr. Wells goes into the history of both fisheries and the methods of capture, giving details of the catches of whitebait, which mainly consists of the fry of herrings and sprats but may contain also about twenty other species of young fishes. He also describes the proper way to cook it, and how to distinguish the herring of whitebait size from that of the sprat.

Rabbits and Traps

THE next Parliamentary session will see a bill introduced in the House of Lords by Lord Tredegar to prohibit the use of the steel trap. This bill is now in the final stages of drafting by the University of London Animal Welfare Society, which, as the result of a recent questionnaire, claims to be in possession of overwhelming evidence in favour of the abolition of the trap, both on humanitarian grounds and—strange to relate—because it is claimed that trapping results in a *continuance* of the rabbit pest. This claim is founded on the experience of certain landowners, who have abandoned trapping for other methods of extermination simply because they have found that extermination was not to be achieved by means of the trap. Landowners may be deemed to be impartial in a matter of this kind ; for, naturally, they desire to keep rabbits down. They are also keenly alive to the dangers of the steel trap to fox-hounds, domestic animals, partridges and other game. Another of their objections to the steel trap is that it kills stoats, ferrets and other natural enemies of the rabbit pest.

Speed of Snakes

THE general notion that snakes attain great speed of movement is not supported by timed observations made in the United States, and described in a paper read by Dr. Walter Mosaner before the American Association for the Advancement of Science at Berkeley, California (Science Service, Washington, D.C.). Of seven typical North American snakes tested, the red racer was the speediest with a record of three and a third miles an hour, while the Californian boa, moving at a rate of only a quarter of a mile an hour, was the slowest. The author considers that the mistaken idea about the speed of snakes arose from the deceptiveness of the smooth, fluent, undulatory movement, but he admitted that his records might possibly be broken by snakes doing sudden bursts under stress of excitement, and by some tropical snakes which may double or treble the American records.

Mosasaurian Skeletons from Manitoba

ACCORDING to the *Times*, the National Museum at Ottawa, Canada, has lately received two nearly complete Mosasaurian skeletons from an Upper Cretaceous clay in southern Manitoba. They measure respectively 33 ft. and 15 ft. in length, but both lack the end of the tail. Only fragments of these fossil marine reptiles have hitherto been found in Canada, and our knowledge of the group depends chiefly on well-preserved skeletons from the yellow chalk of Kansas, U.S.A. The new specimens were collected, and are now being prepared for study, by Mr. Charles M. Sternberg, son of Mr. Charles H. Sternberg, who collected most of the specimens from Kansas.

A New Platinum Mineral

PROF. O. ZVJAGINSTSEV, of the Russian Platinum Institute, Moscow, has reported, according to the *Prager Presse* of August 18, that a new mineral has been found associated with platinum ores. It contains iridium, osmium, gold and ruthenium as well as platinum. The mineral has a silver-white appearance, is very hard but brittle and has a high specific gravity. Considerable development has recently taken place in the mining of precious metals in Russia.

Last year, for example, as much as 87,000 kgm. of pure gold was extracted, and this exceeded the Canadian production. It also represented an increase of forty per cent over the amount obtained in 1932. More still is expected to be obtained in the present year.

Grassland Research in Australia

IT is not often that research workers are able to review the whole field of their particular investigation in their own country, but grassland agronomists in Australia are placed in this fortunate position by the appearance of Bulletin No. 14 of the Herbage Publication Series of the Institute of Agricultural Botany ("Grassland Research in Australia", Imperial Bureau of Plant Genetics, Aberystwyth, Great Britain, 3*s*., February 1934). The bulletin contains a comprehensive survey of Australian research work on pasture management and improvement, the genetics, pests and diseases of grass crops, poisonous plants, the introduction of new species and plant physiology as it relates to grasses. For each research centre, the names of the investigators, the scope of the work, experimental procedure and references to published results are given. Two original papers on "The Technique of Pasture Investigations" by J. Griffiths Davies and H. C. Trumble, and "Botanical Analysis of Irrigated Pasture" by E. S. Beruldsen and A. Morgan are also included in the bulletin.

Physics in National Planning

IN an article on this subject which Prof. Karl T. Compton, of the Massachusetts Institute of Technology, contributes to the July issue of the *Review of Scientific Instruments*, he points out that physics has given birth to nearly all those ideas which have led to the understanding and use of the forces of Nature; that almost every branch of industry has benefited from it, and that the pace at which it is developing at the present time assures us of its increasing power to help in the future. A nation which, by anti-educational policy or by inadequate provision for research, puts itself industrially at the mercy of more progressive nations, is courting economic distress and unemployment for the next generation. He considers that the United States Government, in spending only one half of one per cent of its annual budget on its scientific bureaux, is showing a lamentable lack of vision. He urges re-consideration of the place of science in national planning and policy, and better provision for it in the future.

The U.S. National Research Council

IN several issues of *Science* during 1933, articles by various authors have appeared surveying the organisation of, and suggestions for needed changes in, the United States National Research Council. These articles have now been issued in pamphlet form as a partial record of the accomplishments of the National Research Council ("A History of the National Research Council, 1919–1933". Washington, D.C. 1933. 50 cents). A survey of the organisation and activities of the Council is contributed by Dr. Albert L. Barrows, its assistant secretary. The Council originated in an offer made by the National Academy of Sciences of its services to President Wilson in 1916, when it was seen that the United States would become involved in the War. The Council was finally established as a perpetual body on May 18, 1918. The organisation and activities of the following divisions are described by their respective chairmen: Physical Sciences, Prof. F. K. Richtmeyer; Engineering and Industrial Research, Prof. Dugald C. Jackson; Chemistry and Chemical Technology, Prof. Charles A. Kraus; Geology and Geography, Prof. W. H. Twenhofel; Medical Sciences, Prof. Stanhope Bayne-Jones; Biology and Agriculture, Prof. Fernandus Payne; Anthropology and Psychology, Prof. A. T. Poffenberger. An account of the Research Information Service is contributed by its director, Dr. Clarence J. West, and the assistant secretary of the Council describes the various divisions of general relations (federal, foreign, States and educational). A list of publications is appended.

History of Medicine Congress

THIS year's Congress of the German Society of the History of Medicine will form part of the ninety-third Congress of the Society of German Men of Science and Physicians, which will be held at Hanover on September 18–19. The following subjects, among others, will be considered: bone finds in the Alamannic graves, by Prof. Georg Sticker; racial ideas in India, by R. F. G. Möller; Velasquez and the doctrine of heredity by Prof. Haberling; a contribution to the study of medicinal plants, by Edith Heischkel; Cæsarean section by midwives, by Elsaluise Haberling; Novalis and Romanticism, by Prof. Paul Diepgen; Urso, the last doctor, philosopher and theologian at Salerno, by Dr. Rudolf Creotz; the medical faculty at the University of Tyrnau, by Prof. T. von Györgi; the correspondence of Drs. Zimmermann and Espenburg with Kotzebue, by Dr. W. Leibbrand; Kestren, the Frankfort municipal doctor, by Dr. Kallmorgen; national and political tendencies in the congresses for natural science 1822–48, by Dr. Ludwig Englert, and Caspar Friedrich Wolff, by Dr. Julius Schuster. Further information can be obtained from Dr. W. Artelt, Universitätsstrasse 3b, Berlin, N.W.7.

Sixth International Congress for Scientific Management

AT the Sixth International Congress for Scientific Management to be held in July of next year, arrangements have been made for the discussion of many papers giving accounts of management in relation to a variety of problems. These include business forecasting, budgetary control, the inculcation of best methods of management, production control and technique, standardisation, the distribution problems of manufacturers, wholesalers and retailers, selective education and training for high administrative positions. Many international and national problems would be affected by the greater use of scientific method. The management of

industrial and agricultural undertakings is gradually being based on more precise data and on improved techniques of management independent of the many and specific points on which scientific workers of different kinds—chemists, physicists, geologists and many others—are qualified to advise. Management consists in taking decisions with due regard to the multifarious factors of the organisation either within or without the control of the manager. The Congress is well supported by a large number of professional bodies and by eminent industrialists. H.R.H. the Prince of Wales is the patron; the chairman is Sir George Beharrell. Dr. E. F. Armstrong and Sir Henry Fowler are among the chairmen of committees. The fuller programmes and membership forms will be available from Mr. H. Ward, 21 Tothill Street, London, S.W.1, at the end of October. The papers to be discussed will be printed in six volumes and be available to members before the Congress.

Announcements

THE next meeting of the General Assembly of the International Astronomical Union will take place in Paris on July 10–17, 1935.

ON October 13, Sir E. Hilton Young, the Minister of Health, will open the Stenhouse Williams Memorial Library at the National Institute for Research in Dairying, Shinfield, near Reading. The Library was founded in memory of Dr. Stenhouse Williams, the first director of the Institute, who died on February 2, 1932.

THE Sixth International Botanical Congress will be held at Amsterdam on September 2–7, 1935 (see NATURE, 132, 780, Nov. 18, 1933). The Congress will be divided into the following sections: (1) Agronomy, (2) Cytology, (3) Genetics, (4) Geobotany, Ecology and Phytogeography, (5) Morphology and Anatomy, (6) Mycology and Bacteriology, (7) Phytopathology, (8) Palæobotany, (9) Plant Physiology, (10) Taxonomy and Nomenclature. The principal topics for discussion have been selected. Further information can be obtained from the Secretary, Dr. M. J. Sirks, Wageningen, Holland.

THE twenty-fifth edition of Messrs. Becker and Co.'s (17–29 Hatton Wall, London, E.C.1) catalogue of chemical apparatus, chemicals and general laboratory equipment has recently been issued. It contains 856 pages, and describes a wide field of apparatus and equipment. Recent advances in chemical apparatus are represented by the increasing number of electrically heated units, and the use of special materials such as silica and monel metal for the construction of apparatus. We also note the low-pressure apparatus, including the Kaye steel mercury diffusion pump; thermoelectric equipment and pyrometers; pyrex apparatus with interchangeable standard ground joints; biological apparatus, including microscopes; and projection apparatus. The catalogue will be useful in any laboratory.

MESSRS. WILLIAMS AND NORGATE, LTD., announce that they will shortly issue on behalf of the Herbert Spencer Trustees a volume by Prof. John Garstang, professor of sociology in the University of Liverpool, on "The Kingdom of Solomon" as one of the volumes of the Descriptive Sociology Series.

A COMPREHENSIVE treatise on the principles and practice of the production and refining of mineral oils entitled "The Science of Petroleum" is in preparation for publication by the Oxford University Press. The British editors are Dr. A. E. Dunstan, chief chemist of the Anglo Persian Oil Company, Prof. A. W. Nash, Department of Oil Engineering, University of Birmingham; and Mr. H. T. Tizard, rector of the Imperial College of Science. The chief editor in America is Dr. B. T. Brooks. The work will contain articles by nearly three hundred authorities from all parts of the world; every aspect of the science of petroleum is being discussed in articles which, it is hoped, will be authoritative and definitive.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A technical officer in the Admiralty Technical Pool chiefly for work in connexion with small precision mechanical and electrical apparatus—Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (Sept. 4). A teacher (evening) of heat engines and hydraulics at the Central Polytechnic, Scarbrook Road, Croydon—Principal (Sept. 10). An assistant curator in the Royal Albert Memorial Museum, Exeter—Town Clerk, endorsed "Assistant Curator" (Sept. 12). A chief inspector of aircraft in the Civil Aviation Directorate of the Government of India—High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Sept. 12). An assistant at the Fuel Research Station, East Greenwich, for work on the preparation of reports and abstracting of technical papers in connexion with the Fuel Research Coal Survey—Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (Sept. 15). Assistant civil engineers in the Civil Engineer-in-Chief's Department, Admiralty—Civil Engineer-in-Chief (Sept. 15). A junior technical examiner (male), formerly known as draughtsman, in the Lands Branch of the War Department—Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (Sept. 20). An engineering chemist, Public Works Department, Gold Coast—Director of Recruitment (Colonial Service), 2 Richmond Terrace, London, S.W.1 (Sept. 30). A professor of pure mathematics in the University of Sydney, Australia, particulars obtainable from the Universities Bureau of the British Empire, 88A Gower Street, London, W.C.1—Registrar, University of Sydney (Oct. 15). An assistant (Grade III) for work on general aircraft instrument design and test in the Directorate of Technical Development, Air Ministry—Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (quoting reference No. A.617). A laboratory assistant (male) at the War Department's Experimental Station, Porton—Commandant, Experimental Station, Porton, near Salisbury.

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Crystallisation of Metals from Sparse Assemblages

IN the course of an extended investigation into the properties of thin metal films, of the order of 50 atoms in thickness, we have observed an early stage in the crystallisation which presents peculiar properties. The films, of gold and of silver, were prepared by cathodic sputtering on various carefully cleaned surfaces—optical glass, quartz glass and the natural face of a diamond crystal. The nature of the surface has no effect on the phenomena to be described.

The films, as prepared, appear completely homogeneous under various types of illumination, and with magnifications up to 1,000 times, obtained with a $\frac{1}{12}$ in. oil immersion apochromatic objective, N.A. 1·30. After the film has been heated *in vacuo* for two or three hours at a temperature of about 280° C., small specks, about 0·5–1 μ across, can be observed on it, which, in transmitted light, at a magnification of 1,000, appear a golden brown colour. Examined in a polarising microscope, the illumination being plane polarised light, and the nicols being crossed, each particle appears on the dark ground as white, with a black cross imposed. In all particles, the arms of the cross are parallel to the analysing and polarising nicols respectively. This figure is characteristic not of a uniaxial crystal, which shows the familiar 'rings and cross' in *convergent* light, but of a spherulite, and is, in fact, called the 'spherulitic figure' by Morse, Warren and Donnay[1] in their paper on artificial spherulites. Such spherulites are made up of crystalline fibres, closely packed, and radiating from a centre, each

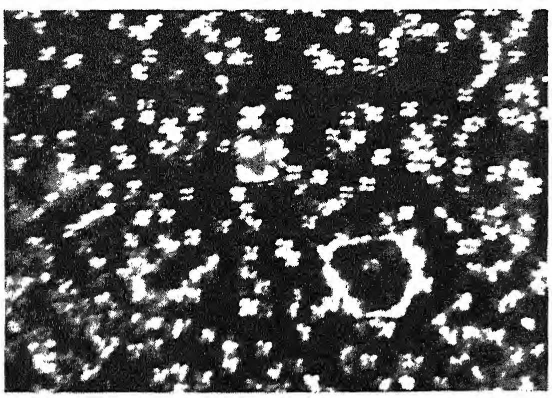

FIG. 1. Spherulitic particles on a silver film, and a large cubic crystal with birefringent edges. The spherulitic particles on the top of this crystal itself are due to a second sputtering, and subsequent heating. (× 2,000.)

fibre behaving as a uniaxial crystal with its axis along a radius. The appearance shown by the small particles in Fig. 1, which represents a heated silver film under a magnification of 2,000, exactly resembles that of the artificial spherulites of mercuric oxide, about 3 μ across, shown in the paper just quoted.

Prolonged heat treatment at temperatures up to 340° C. leads to the growth of the particles, but they lose their spherulitic nature, and become well-formed crystals of cubic type, which appear black between crossed nicols, only the edge remaining doubly refracting, as shown by the large crystals in Fig. 1. Interesting results have been obtained as to the faces of preferential growth of the cubic crystals, and their relation to the plane of the surface on which the film is deposited.

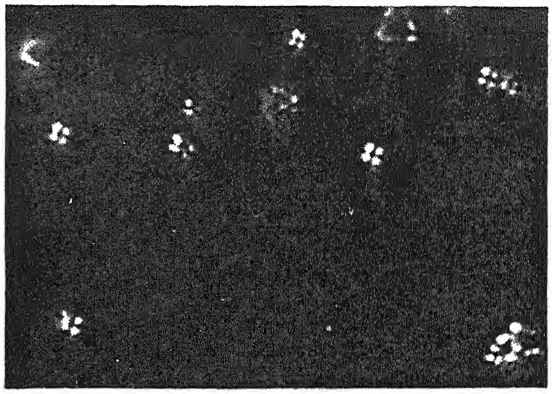

FIG. 2. Spherulitic particles of gold formed by reduction in silicic acid gel. (× 2,000.)

It appears then, that, when gold or silver crystals grow very slowly from a film, in which the amount of material available for incorporation at any moment is small, the first stage of crystallisation is an aggregate of a spherulitic nature, in which the individual crystalline fibres behave as if uniaxial, although the normal crystalline form of the metals in question is cubic, that is, optically isotropic. This may be qualitatively explained by supposing that, in a film only 50 atoms across, the cubic lattice is not a stable arrangement when the upper layers are mobile, as, from evidence obtained by us, they are in gold and silver films at 300° or so. It is suggested that particles from these upper layers form a small local cluster, which is largely isotropic in the early stages of growth, but soon begins to form small regions, or facets, in which a crystalline regularity is established. From these facets grow out the crystalline fibres, possibly with regions of unordered atoms between them. The spherulites are some 2,000 atoms across, so that if the number of fibres is of the order 100, the fibres will be about 30 atoms across and 1,000 atoms long. In such a fibre the crystalline structure may well be sufficiently disturbed by the smallness of the transverse dimension, expressed in number of atoms, to behave as uniaxial. It is, of course, possible that the aggregates are not complete spherulites, but are conical segments of a spherulitic nature, as is a single 'set' in a smectic liquid-crystal layer. The highest possible optical resolution is not sufficient to show the difference between the figure to be expected with a complete spherical aggregate, and with a portion, so long as the angle of the cone is wide.

It seemed possible that a spherulitic aggregate might be the first stage in other methods by which crystals of pure metals are grown from sparse assemblages. Crystals of gold were therefore grown by reduction from gold chloride in a silicic acid gel. After the formation of so-called colloidal particles

the gel was washed away, and the particles, about 1 μ across, collected on a glass plate. They proved to show the spherulitic figure, and were practically indistinguishable from the particles slowly grown in the gold and silver films (Fig. 2). Well-formed crystals with birefringent edges were also observed, and can be seen in the photograph.

This appears to be the first occasion on which spherulites of pure metals have been observed. They may have an important bearing on the question of the stability of the crystal lattice.

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July 27.

[1] H. W. Morse, C. H. Warren and J. D. H. Donnay, *Amer. J. Sci.*, **23**, 421; 1932.

The New Field Theory

IN a recent series of articles[1] Born has developed, with Infeld, a new theory of the electromagnetic field that solves the difficulties connected with the self-energy of the electron. In II an elegant form is given for the Lagrangian of the electromagnetic field, but the Lagrangian alone does not completely specify the electromagnetic field since one must add the assumption[2] that f_{kl} is the curl of a potential vector φ_k. The method suggested[3] for including the Einstein gravitational equations within the theory would further mar the elegance of the Lagrangian.

It seems possible to give a Lagrangian function based upon the projective theory of relativity[4] which will not only lead to the Born field equations in the Galilean case, but will at the same time automatically make f_{kl} the curl of φ_k, and will also contain ten further 'gravitational' equations. The Lagrangian lacks the elegance of that proposed in II, and the field equations derived from it are extremely complicated.

In the projective theory of relativity the gravitational potential g_{ab} and the electromagnetic potential φ_a enter the projective metric $\gamma_{\alpha\beta}$ in such a way that the projective curvature scalar has the value

$$B = R - \varphi^a_b \varphi^b_a = R + g^{ac} g^{bd} \varphi_{bc} \varphi_{da},$$

where R is the Riemannian curvature scalar of the g_{ab}, and φ_{ab} is, apart from a factor, the curl of φ_a. If we define field equations as the conditions that the variation with respect to the $\gamma_{\alpha\beta}$ of the invariant integral

$$\int (\sqrt{1 + \alpha B} - 1) \sqrt{-g}\, dx^1 dx^2 dx^3 dx^4 \ (\alpha \text{ a constant})$$

shall vanish, the four field equations corresponding to the variation of φ_a will, in the Galilean case, reduce to those of I[5] and will therefore lead to the static field obtained in both I and II.

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July 19.

[1] For example, *Proc. Roy. Soc.*, **143**, 410; 1934; referred to as I, and **144**, 425; 1934; referred to as II.
[2] II, p. 433, Eq. (3·1).
[3] II, p. 435.
[4] See "Projektive Relativitätstheorie", O. Veblen, *Ergebnisse der Math.*, Berlin, 1933.
[5] With the constant subtracted as in I, p. 432, Eq. (7·10).

Further Band Systems of Aluminium Hydride

SOME new band systems of aluminium hydride at 2700 A. and 4950 A. have already been reported[1]. Using a new construction for the aluminium electrode which permitted large energies in the arc at a high pressure of hydrogen, we have obtained the band system at 4950 A. in the first order of our 6·5 m. concave grating. The band system has been analysed and is found to belong to a $^1\Sigma^{***} \rightarrow {}^1\pi$ transition, where the lower term $^1\pi$ is in common with the well-known band system $^1\pi \rightarrow {}^1\Sigma$. Of the three branches expected (P, Q, R) only the Q and P branch has been found, owing to the strong overlapping from the AlO bands. The following constants have been evaluated.

	B_0	D_0	J_0	r_0	ω_0 cm.$^{-1}$	ν_0 cm.$^{-1}$
$^1\Sigma^{***}$	6·120	$-11{\cdot}33 \times 10^{-4}$	$4{\cdot}53 \times 10^{-40}$	1·68 A.	900	20277·16

From the combination rule of R. de L. Kronig and ground state $^1\Sigma^+$ of AlH predicted by Mulliken, it is found that the term is $^1\Sigma^-$.

Like most of the band systems of aluminium hydride, the band at 4950 A. shows a remarkable 'cut off' of the series. The P and Q branches are both cut off at $j = 19$. Accordingly, the predissociation originates from the $^1\pi$ term.

E. Hulthén and R. Rydberg[2] consider that the predissociation and the pressure effect in the lowest $^1\pi$ term of aluminium hydride is due to a 'barrier' 400 cm.$^{-1}$ above the dissociation limit. Owing to a leak past this barrier, the terms higher than $j = 20$ in v_0 are diffuse. Perhaps this explains the predissociation in the new $^1\Sigma^{***} \rightarrow {}^1\pi$ system.

Details will be published elsewhere.

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University of Stockholm.
July 2.

[1] *Z. Phys.*, **89**, 40; 1934.
[2] NATURE, **131**, 470, April 1, 1933.

Situation of the A ($^3\Sigma$) Level in the Nitrogen Molecule

HERZBERG and Sponer[1] have recently reported that the $A(^3\Sigma)$ level of N_2 lies 6·14 volts above the X (ground) level. They have assumed in deriving this value that Kaplan's new band system[2] is indeed the intercombination $A - X$. For this hypothesis the spacing of Kaplan's upper vibrational levels affords some support. On the other hand, direct estimates of the position of this level by the method of electron collision, including Sponer's[3] original determination, agree in placing it at least two volts higher than the above value.

A careful repetition of Sponer's determination employing many technical refinements has recently been completed in this laboratory. We obtain $8{\cdot}34 \pm 0{\cdot}05$ volts for the interval $A - X$, in substantial agreement with previous results, but with an accuracy much greater than that claimed by any previous worker. A detailed account of this work will appear elsewhere.

If Herzberg and Sponer's assignment is to be accepted, this discrepancy must be explained. Their suggestion that in all electron collision measurements the excitation of the Second Positive Bands is due to a secondary collision process does not appear to us adequate. First, at the pressures used in our experiments (3×10^{-3} mm.) such collisions are

unlikely to occur with sufficient frequency, and secondly (what is much more important), we find that bands starting from different upper vibrational levels give excitation potentials differing from each other by amounts corresponding to the difference of these levels as given by spectroscopic data. It seems to us impossible that any secondary process could leave these differences intact.

Herzberg and Sponer's assignment is based upon a few combinations differing by several wave-numbers from the accepted spacing for the vibrational states of the A level, and though the agreement is suggestive, it is scarcely sufficient to establish the identity of Kaplan's upper level in the face of conflicting evidence. In any case, even if the disagreement in the combination differences should turn out to be experimental error, and if the bands are really due to an $A - X$ transition, several other points remain to be explained :—(1) The extremely low value for the dissociation energy of the normal state (7·34 volts) as compared with that obtained by extrapolation of the vibrational levels (11·75 volts). (2) The presence of the bands only under special conditions of excitation, though the A level is being rapidly populated by cascade from both $^3\Pi$ levels in any kind of discharge tube. Spectrograms of our electron beam at low pressures (1×10^{-3} mm.) show no trace of Kaplan's bands. This implies that their intensity even at these low pressures must be less than 1/100 the intensity of the Second Positive Bands. (3) Their non-appearance in absorption.

We therefore believe that the weight of evidence is still in favour of the higher value of the interval $A - X$.

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July 18.

[1] Herzberg and Sponer, *Z. Phys. Chem.*, B, **26**, 1 ; 1934.
[2] Kaplan, *Phys. Rev.*, **45**, 675 ; 1934. Kaplan, *Phys. Rev.*, **45**, 898 ; 1934.
[3] Sponer, *Z. Phys.*, **34**, 622 ; 1925.

Relative Toxicity at High Percentages of Insect Mortality*

DOSAGES of toxic materials sufficient to ensure complete mortality of a given population have not been determined very precisely in the past, because of the nature of the S-shaped toxicity curve. Numerous estimates of relative toxicity, based on dosages to kill only 50 per cent of a population, have been published. Precision thus obtained is often of distinct advantage in theoretical studies of various factors which influence toxicity. It is obvious, however, that, depending upon the percentage of mortality taken as a basis for comparison, the toxicity relations of two compounds may vary. For example, 50 per cent of a population of rice weevils (*Sitophilus oryzæ* L.) are killed by a dosage of 23 mgm. per litre of carbon disulphide or by one of 35 mgm. of ethylene dichloride. If comparisons are made at 75 per cent mortality, the curves are found to be sharply divergent, the respective dosages being 27 and 62 mgm. per litre. No simple factor, therefore, can be used with which to multiply the 'median lethal dose', and to obtain the amount to kill approximately 100 per cent.

In fields such as those of insecticides, fungicides and bactericides, it is important to have some reliable means of estimating dosages at high mortalities. Bliss[1] has suggested a method of estimation of points approaching complete mortality. Investigators, such as Langmuir, working with adsorption equilibria, Robertson with growth, and Hecht with visual acuity, have fitted S-shaped curves to their data,

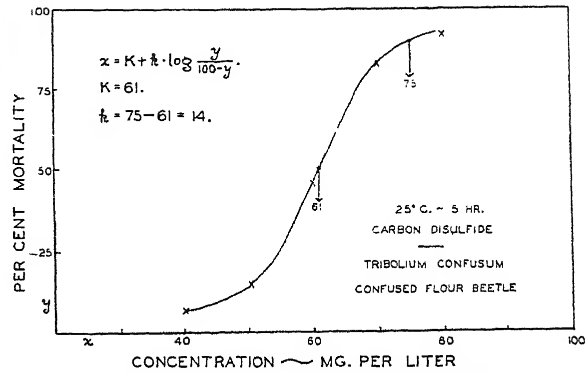

FIG. 1. Curve drawn through weighted means of original data.

although not primarily for the determination of the 100 per cent effect. A simple form of their formula has been used rather successfully by the author to fit curves in about 75 cases in a study of the action of fumigants on stored product insects. The formula used,

$$x = K + k \times \log \frac{y}{100 - y},$$

is based on that applied to hydrogen ion concentration by W. M. Clark. K is the point of 50 per cent

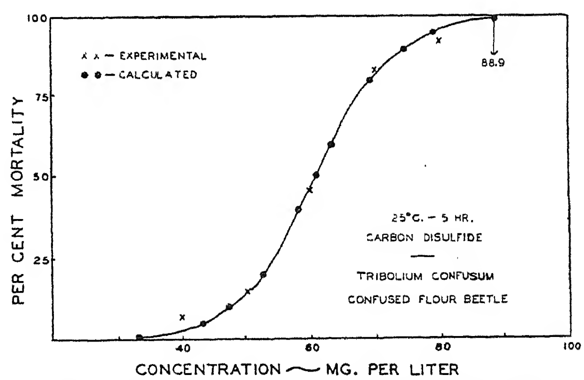

FIG. 2. Calculated curve superimposed upon the same means.

mortality and fixes the position of the curve on the horizontal axis, whereas k is the difference between the 90 and 50 per cent points and fixes the slope ; x and y are dosage and percentage mortality respectively. It is possible to determine the 90 per cent point with nearly the precision of the 50 per cent. Data at only 4 or 5 points are necessary, the highest one between 90 and 95 per cent kill and the lowest one or two points between 20 and 45 per cent. It is very important to use a large population in a number of smaller groups to obtain data for each point. 1,472 beetles were used to obtain the data

* Paper No. 1,273 of the Scientific Journal Series of the Minnesota Agricultural Experiment Station.

shown in Figs. 1 and 2, from 207 to 430 individuals to each point.

The curve calculated by the formula is perfectly symmetrical whereas the experimental one may or may not be. It is not necessarily a natural attribute of the population to produce a skew curve. The degree of skewness can be shown to vary from none to considerable when the temperature is varied at which a population of beetles is fumigated. Skewness of the experimental data is of little consequence in the present connexion; if the fit is good between 50 and 100 per cent the skewness at the lower end of the curve may be disregarded.

Two factors affect precision in any method for estimating high percentages of mortality. First, the sharper the distinction between living and dead individuals, the easier it is to determine where the toxicity curve will probably reach 100 per cent. Secondly, since an *S*-shaped curve is asymptotic at high percentages, estimates of complete kill by any method involving a consideration of the course of toxicity, must be calculated at a figure slightly less than 100 per cent. The point chosen may vary with the method used. The author has found the 99·0 per cent values calculated by his formula to represent very good estimates of the 'maximum non-lethal dose'.

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July 12.

[1] Bliss, C. I., *Science*, 79, 38–39, 409–410; 1934.

State of the Earth's Central Core

It would be premature to discuss at length the identification of *S* waves through the earth's core, announced by L. Bastings[1], until the complete paper is available. Nevertheless, the failure of previous investigators to detect these waves with any confidence invites comment. If the waves are real, this result must be due either to their smallness and indistinctness, or to their nearness to others that must theoretically exist. The earthquake considered by Bastings has been also used by Miss I. Lehmann[2]; in her first paper, the *P′* waves are considered, while the later one gives a diagram showing the readings of all from *P′* to *SS*, at distances from 160° to 170°. The actual seismograms must be mainly the same as those read by Bastings. She proceeded by reading all the more striking movements without reference to their interpretation and afterwards comparing them with the theoretical times. Inspection of her diagram gives no impression that any movements besides the two branches of *P′*, *PP*, *SKS*, *PPP*, *SKKS*, *SKSP*, *PPS*, and *SS* are capable of being traced over this range of distance, and even of these, *SKS* and *SKSP* show such a scatter from any smooth curve as to make the identifications doubtful. Presumably they are real but small or with indefinite commencements. She finds *PPS* early in comparison with Gutenberg's times, and this may be what Bastings has identified as S_1'. The difference between the observed times of this pulse and Gutenberg's calculated times for *PPS* may, however, arise from the errors of Gutenberg's times, which are reasonably good but still require some correction, and at present I am inclined to think that the pulse read is really *PPS*.

It appears that the existence or otherwise of *S* waves through the core will have to depend on the possibility of separating them from *PPS*, and must await more definite information about the latter. In our recent revision of the tables, Mr. K. E. Bullen and I found anomalies in *PS* that have not yet received interpretation, and these will probably be intensified in *PPS*.

The lack of rigidity in the core does not rest wholly on the past failure of seismologists to identify *S* waves through it. If the rigidity of the core stood in the same ratio to the bulk modulus as holds for the shell, the earth's tidal yielding would be much less than it is, but the actual bodily tide is consistent with fluidity of the core[3]. If Bastings's interpretation is correct, it will be necessary to suppose that the core is elasticoviscous, behaving as a solid for stresses with periods of a few seconds but as a liquid for a period of 12 hours; and it remains to be seen whether such a constitution would not give an impossible amount of tidal friction.

Harold Jeffreys.

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[1] Nature, 134, 216, Aug. 11, 1934.
[2] *Gerlands Beiträge z. Geophysik*, 26, 402–412; 1930. *Verhandl. d. 5 Tagung d. Balt. Geodät. Komm.*, 192–212; 1931.
[3] "The Earth", 239; 1929. *Mon. Not. Roy. Ast. Soc., Geoph. Suppl.*, 1, 371–383; 1926.

Magnetron Oscillations

In a recent issue of Nature[1], Dr. K. Posthumus has reported the production, by means of the split anode magnetron, of short-wave oscillations, which he suggests are of a new type. The oscillations occurred when the magnetic field strength exceeded the critical cut-off value and were characterised by an inverse relationship between frequency and optimum magnetic field strength.

It would appear that these oscillations are identical with the so-called 'dynatron' oscillations which I have discussed in a recent paper[2]. For relatively low frequencies it has been shown that the performance of such an oscillator can be predicted from the observed static characteristics, at least in the case of a two-segment anode. At high frequencies (corresponding to wave-lengths of the order of 1 metre) the dynamic characteristics differ from the static 'dynatron' characteristics due to electron inertia. At such frequencies two important effects occur: (1) the bombardment of the cathode[3] by some of the electrons the energy of which is increased by the change of electric field during their transit; and (2) the time of transit can be controlled by adjusting the ratio of V_a to H as described by Dr. Posthumus, so that many of the electrons reach the anode with radial velocities less than those corresponding to static conditions. Due to these effects, the anode current and the efficiency may both exceed the values predicted from the static characteristics.

The equation for a two-segment magnetron given by Dr. Posthumus becomes, in terms of wave-length instead of frequency,

$$\lambda = 300\,\pi\, r_a^2\, H/V_a \text{ (practical units).}$$

Combining this with the equation

$$H = \sqrt{181\ V_a}/2r_a$$

defining the critical magnetic field strength, we obtain

$$\lambda_0 = 6 \cdot 4 \times 10^3\, r_a/V_a^{\frac{1}{2}} = 3 \cdot 2 \times 10^3\, d_a/V_a^{\frac{1}{2}}$$

for the minimum wave-length in terms of anode

diameter and voltage. The similarity between this result and my empirical equation[2]

$$\lambda_0 = 3{\cdot}6 \times 10^3\, d_a/V_a^{\frac{1}{2}}$$

leaves little doubt as to the identity of the two 'types' of oscillation.

In an attempt to carry the multiple-segment anode construction to its logical conclusion, a 'squirrel-cage' anode system was tried some time ago in these Laboratories. In this, successive bars were connected to opposite sides of the oscillatory circuit. The performance was, however, much less encouraging than that quoted by Dr. Posthumus for his four-segment valves, possibly due to the filament being too well centred in the anode.

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Aug. 7.

[1] NATURE, **134**, 179, Aug. 4, 1934.
[2] *J. Inst. Elec. Eng.*, **72**, 326; 1933.
[3] Megaw, NATURE, **132**, 854, Dec. 2, 1933.

Rôle of Insulin in Peripheral Metabolism

PREVIOUS efforts to ascertain the mechanism of insulin have indicated that it is in the peripheral metabolism. We have been investigating its focal point in the respiratory cycle of the cell and the peripheral metabolism of the carbohydrates.

The method employed was to utilise the effect of substances which have been previously used as inhibitors of respiration (ethyl urethane and cyanides) and sodium fluoride and iodoacetic acid, which latter affect the carbohydrate metabolism and have been used in the study of glycolysis in yeast and muscle extracts. Maximum tolerated doses of these compounds have been administered to rabbits, and their relative effect studied upon the action of insulin in doses of 1 unit per 2 kgm. weight of the animal.

The hyperglycæmic effect of narcotics, cyanides and iodoacetic acid have been reported by others. We have found that sodium fluoride likewise produces a hyperglycæmia, and we have based our conclusions on the assumption that the hyperglycæmia in these cases is largely due to their antagonistic action at the periphery rather than solely to the deglycogenation of the liver. In confirmation of this view, we have found that the standard unit of insulin used will render an animal hypoglycæmic to the point of convulsions if the hyperglycæmia is due to deglycogenation of the liver, where the peripheral metabolism is intact.

Our results indicate that the insulin mechanism is largely concerned with the reaction between α-glycero-phosphoric acid and pyruvic acid, resulting in the formation of lactic acid. Embden's scheme[1] has been used as the basis of the intermediary metabolism in the tissues.

This communication is in the nature of a preliminary report, and we are applying these results to the study of insulin action in muscle strips.

N. B. LAUGHTON.
A. BRUCE MACALLUM.

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London,
Ontario.
July 30.

[1] *Ann. Rep. Chem. Soc.*, **30**, 331.

Intensity of the Cosmic Ultra-Radiation in the Stratosphere with the Tube-Counter

ON July 24 we succeeded in sending up a Geiger-Müller tube counter by registering balloons into the stratosphere to a height of 28 km. The sensitivity of the tube counter was the same for rays from all directions. The apparatus was protected against the low air temperature in the stratosphere in the same way as previously described[1] by a case of 'Cellophane', so well that the lowest temperature at the greatest height was + 17° C. Therefore there was no influence of the temperature on the counting device. The indications of pressure, temperature and counting apparatus were recorded by a photographic plate every four minutes.

It is remarkable that the curve of impulses obtained with the tube counter is in shape identically the same as that obtained by the ionisation chamber; especially at heights above 18 km., there is no increase of the number of impulses. From these results we may conclude that the specific ionisation power of the ultra-radiation is practically the same for the whole region investigated from the surface of the earth up to 28 km. We found that the specific ionisation cannot be greater than 103 pairs of ions per cm.

A more detailed report of the investigations will be published shortly in *Physikalische Zeitschrift*. We wish to thank the Notgemeinschaft der deutschen Wissenschaft for providing the means that enabled us to make these investigations.

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[1] NATURE, **133**, 364, Sept. 3, 1933.

Speed of a Golden Eagle's Flight

ON the evening of July 24 I had the opportunity of measuring the speed of an eagle's flight with greater accuracy than is usually possible. From my house I was gazing at the several summits of An Teallach (3,483 ft. and three miles away) through a stalking telescope. I noticed an eagle in the air above Sàil Liath (3,150 ft.). The eagle's flight was irregular and on more careful scrutiny it was possible to see two peregrine falcons stooping at her. The eagle soared to about 5,000 ft., coming nearer, and from an undetermined position made a downward sweep across the glen and out of sight on Meall an Duibha behind my house. The peregrines followed but were left behind. The time taken on this downward flight was about one minute and the distance approximately three miles.

This observation is almost worthless in itself, but half an hour afterwards I was walking to my weather station at 1,000 ft. on Meall an Duibha, immediately behind the house. At this altitude, the eagle rose from the ground about three hundred yards in front of me and the peregrines followed. I glanced at my watch, taking the position of the seconds and minutes hands. The eagle soared and I focused my glass. She reached a height which I could not estimate with certainty, but was probably 4,000 ft. The peregrines were still stooping but never actually struck. Having reached her height, the eagle made another sweep and I was able to see her land on one

of the buttress cliffs of Sàil Liath at an altitude of 2,000 ft. The time taken on the whole of this return flight was 1 min. 45 sec.

I measured the distance on the 1-in. Ordnance Survey map between the points of the eagle's rising and landing and found it to be exactly 3½ miles. This makes the rate of flight 120 miles an hour with a net gain in altitude of 1,000 ft. There was a very slight cross wind from the west. The peregrines were left far behind on the downward sweep. We have, therefore, a timed flight in a straight line (in plan) between two known points, the flight being made with, presumably, some urge towards maximum speed.

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July 31.

Causes of Suppression of Crossing-Over in Males of *Drosophila melanogaster*

THE possibility of artificially inducing crossing-over in males of *Drosophila melanogaster*[1] has enabled us to attempt by genetic methods the study of the direct causes of the suppression of crossing-over in *Drosophila* males. Investigations on the effect of inversions on crossing-over evoked by subjecting *Drosophila* males to X-ray treatment may apparently throw light on this problem.

The experiments carried out by me in the winter of 1933–34 have shown that inversions in males throughout regions of chromosomes not touched by them, inhibit crossing-over in a much feebler degree than in the case of females, and this means that inversions in spermatogenesis cause a smaller 'conflict of forces' than in ovogenesis.

These data point to a diminution of forces of attraction between homologous loci of chromosomes in spermatogenesis, which does not affect the degree of proximity of homologous chromosomes indispensable to crossing-over, nor does it gainsay in principle the possibility of crossing-over: it is necessary only to X-ray the males when, as also with females, a closer junction of the long autosome's central parts during conjugation is brought about and the potential possibilities of crossing-over in the male are thereby accomplished.

A feebler effect of the forces of attraction between homologous loci of the chromosome ought not to hinder chromosome conjugation by the regions of attachment of the spindle fibre. Here, most likely, crossing-over normally occurs in males. This is Darlington's opinion[2]. However, this point of view is not confirmed genetically, as the regions here indicated are genetically inert and crossing-over in the long two-armed autosomes of *D. melanogaster* is usually accomplished in each of the limbs, and is in this case always a double one.

It is noteworthy that these data and deductions fully coincide with cytological data of Koller and Townson[3], which deal with the same subject.

A detailed account of this work will be published shortly.

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July 20.

[1] Friesen, H., *Science*, **78**, No. 2031; 1933; and Friesen, H., *Biol. Z.*, **54**, H. 1/2; 1934.
[2] *J. Genetics*, **24**, 65–96; 1931.
[3] *Proc. Roy. Soc. Edin.*, **53**, 130–146; 1932–33.

Inland Water Survey

THE leading article in NATURE of August 4 and Admiral Sir Percy Douglas's letter in the following issue referring to it deal with a subject of very real importance.

That the public supply of good water to every individual of the whole of the inhabitants of Great Britain should be the first consideration of a Government would no doubt be accepted by most people without much argument, for it is the basis of the good health of the community. But this is by no means the case, singular as it may seem. We have a completely interlinked and co-ordinated supply system for electricity for the whole country but in water supply the Victorian ways persist. Almost complete individualism is still the practice both within and without the Ministry. Any development, however remotely akin to that of electricity, is anathema. Thus it is that in some districts you can turn on the light but not the water.

In any development for a national water supply, the first great work would be the ascertainment of all our water resources, a hydrogeological survey, and it is to be hoped that the Minister of Health will give thorough consideration to the request of Admiral Douglas's deputation for this.

For myself, being interested in the whole subject, I cannot help but wonder even if we got our survey, unless something more is to follow we should not again be held up, possessing all the information but no power to use it or make others do so. So many definite recommendations to deal with this part of the question have been made by commissions and committees in the past, for example, the interim report in 1920 of the Board of Trade Committee presided over by Sir John Snell, that it ought not to be necessary to quote, requote and add any further reasons in support. Of works of urgent public importance involving in their carrying out much employment, the bringing up to date of our water supply is the first.

ALAN CHORLTON.
Le Zoute.

Free Alumina in Soils

IN the literature of soil science, the assumption is frequently made that, because a soil or product of rock weathering yields, when chemically analysed by acid digestion and fusion methods, a high proportion of alumina, it must therefore contain at least a part of its aluminous components in the uncombined state. That this is not necessarily the case has been indicated[1] by the application of an alizarin adsorption method, devised by me, to a series of laterites, bauxites, kaolins, subsoils and surface soils, including some that are red in colour, collected mainly in the West Indies. The alizarin method depends on the fact (apparently first discovered in 1928 by Schmelev) that gibbsite ($Al_2O_3.3H_2O$) and diaspore ($Al_2O_3.H_2O$) after heating to temperatures around 800° C., but not before heating, develop the ability to adsorb in suitable circumstances appreciable quantities of alizarin. The amount adsorbed may be determined colorimetrically by extracting the stained washed material with acidified sodium oxalate solution.

The procedure was afterwards applied in a study of rock-weathering in British Guiana[2]. Some of the materials tested were nearly identical with those previously exhaustively examined chemically and petrographically by the late Sir John Harrison[3]. Comparison between the results obtained and

Harrison's petrographical determinations demonstrated that, among the various products of weathering of igneous rocks (comprising bauxite, primary laterite, red earths, quartzose sands and kaolins), only those that contained identified gibbsite gave positive evidence of the presence of free alumina by the alizarin test. Hence it is concluded that gibbsite is the chief and perhaps the only form in which free alumina occurs in certain of these products. Being crystalline, gibbsitic alumina presumably cannot contribute to the colloidal attributes exhibited by certain tropical soils, although hydrous iron oxides that usually accompany it may so contribute.

Further evidence of the presence of free gibbsitic alumina in bauxites, laterites and lateritic soils, and its absence from most tropical red earths and kaolinitic earths, has been since obtained by determinations of heats of wetting. Whilst most natural soils yield heat of wetting values commensurate with their degree of colloidality, the values given by the *ignited* soils are small or negligible. Exceptions to this generalisation are presented by gibbsite, bauxites, laterites and lateritic earths containing gibbsite, and by various types of hydrous alumina, all of which exhibit relatively large heat of wetting values after ignition, though not necessarily before ignition. Thus, values ranging from 15 to 20 cal. per gm. have been obtained for ignited gibbsite and highly aluminous bauxites and laterites, whilst many red soils, usually designated 'lateritic', gave very much lower values, and most kaolinitic and bentonitic types of soil gave negligible values after ignition. Thus the heat of wetting test may furnish a simpler and more rapid alternative method than the alizarin test for detecting free alumina in the products of rock weathering and soils. Detailed results for a series of selected soils and other materials are being compiled for publication.

F. HARDY.

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July 12.

[1] Studies in Tropical Soils. (1). Identification and Approximate Estimation of Sesquioxide Components by Adsorption of Alizarin. F. Hardy, *J. Agric. Sci.*, 31, 150–166; 1931.
[2] Studies in Tropical Soils. (2). Some Characteristic Igneous Rock Soil Profiles in British Guiana, South America. F. Hardy and R. R. Follett-Smith, *ibid.*, pp. 739–761.
[3] The Katamorphism of Igneous Rocks under Humid Tropical Conditions. Sir John Harrison, *Imp. Bur. Soil Sci.*, Rothamsted Expt. Sta., June 1934, pp. 1–79.

Crystal Structure of the Alums

WE have been able to determine the complete crystal structure of the alums.

The magnitudes of the F's corresponding to the various (hko) planes we found from X-ray rotation photographs, using the measured F's of Cork[1] as a guide. The signs of the F's were found from a photographic comparison of reflections from $KAl(SO_4)_2 . 12H_2O$, $KCr(SO_4)_2 . 12H_2O$ and $KAl(SeO_4)_2 . 12H_2O$, and on carrying out a double Fourier synthesis, we were able to arrive at a structure which satisfies all intensity considerations, and at the same time all requirements of distances.

The structure is a very beautiful one. Half the waters are grouped round the potassium atoms in such a manner that they also have contacts with two oxygens and one of the aluminium waters. These four contacts are arranged approximately tetrahedrally. The remaining half of the waters form regular octahedra around the aluminiums, and each of these waters makes external bonds with one oxygen and one potassium water. We find that these two bonds and the one from the water to aluminium itself are almost exactly coplanar.

The behaviour of the waters in alum is, therefore, in accordance with the behaviour of water in other hydrated crystals, and with the theoretical model of Bernal and Fowler[2].

The details of the structure are as follows:

Al on (000), etc., K on ($\frac{1}{2}\frac{1}{2}\frac{1}{2}$), etc.,
S on (.31 .31 .31), etc., O on (.24 .24 .24), etc.
O on (.30 .27 .43), etc.
H_2O on (.04 .13 .30), etc., and (.02 $\overline{.02}$ .16), etc.

These parameters mean that the large peak in the Fourier projection in planes parallel to (111) obtained by Cork is due to the coincidence of a number of oxygens and waters, and the real sulphur peak is the smaller one at $\theta = 80°$ in his diagram[3].

We hope to publish a more complete account of the structure elsewhere.

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H. LIPSON.

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[1] Cork, *Phil. Mag.*, 4, 688; 1927.
[2] Bernal and Fowler, *J. Chem. Phys.*, 1, 515; 1933.
[3] Loc. cit., p. 694.

Some Experiments on Heavy Water

THE following results have been obtained with water containing 4–5 per cent H_2^2O.

(1) By crystallising sodium sulphate, normal and heavy water are divided practically equally in the water of crystallisation and the solution.

(2) Diethyl ether dissolves, within this range of concentration, at equilibrium, normal and heavy water in equal quantities. On the other hand, if ether drops are allowed to rise through such water and to dissolve in this manner mainly water out of the interfaces water-ether, then the interfaces prove to be enriched in heavy water.

(3) The compound KH_2PO_2 does not interchange its hydrogen atoms in this solution.

(4) The compound $[Co(NH_3)_6] . (NO_3)_3$ (stable to concentrated nitric acid) interchanges all its 18 hydrogen atoms in this solution. Crystals of the compound in equilibrium with the solution at 0° C. do not interchange their hydrogen atoms.

Full descriptions of these experiments will be published in *Helvetica Chimica Acta*.

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Basle.
Aug. 2.

Lost Fragrance of Musk

APROPOS the statement made in NATURE of July 14, p. 54, that the lost scent of musk (*Mimulus moschatus*) was first noticed in Britain in 1909 —an oft-quoted statement—I think the following reference ought to be put on more permanent record. Mr. Thomas Wilkinson, a native of Lancashire, now a Fifeshire farmer, some sixty years ago began growing musk for the Liverpool market. He soon had a monopoly of the trade and sold 5,000 plants a week during the months of May. In 1898, he stated, he noticed the plants began to acquire a rank, leafy smell, and at the end of the summer he sold his business. Four years later he returned to Liverpool and found the musk plants then on sale scentless.

ERIC HARDY
(Librarian).

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Research Items

Mountain Tribes of New Guinea. Some hitherto undescribed tribes of New Guinea are the subject of a communication from Mr. E. W. P. Chinnery (*Man*, August). They inhabit the great central mountain ranges which are now being examined by administrative officers. Along the Papuan border from Mt. Joseph to Mt. Hagen, and on a wide expanse of grass-covered plateau between the Western Kratke Mountains and Mt. Hagen, are groups of people with methods of garden culture and certain customs not found elsewhere in New Guinea. Of the three groups of these peoples, the western half of the second group and the whole of the third or north-western group have only recently been examined. The so-called Kukukuku groups usually live in small family houses near their gardens; but in the western Tauri there are many large stockaded villages of round houses with conical roofs. Both men and women dress alike. The men are usually clean-shaven and the hair is cut short with a tuft on the top to hold a loop from which is suspended a long cape of tapa cloth for protection against cold and rain. The men use a short bow and arrows, and carry a stone-headed club. They chew betel nut, but do not smoke tobacco. Cannibalism has been reported of the people between the Garfuku River and Kratke Mountains. During inter-tribal warfare the women accompany the men with spare arrows. On the Bena Bena tributary there is a cane-swallowing ritual not previously observed in New Guinea. Some of the adult men wear a long length of thin cane doubled and looped round their necks. They send the women and children away and then push the bent part of the cane down the gullet for several inches, leaving the two ends protruding from the mouth. It is said that a man may have three canes down his throat at the same time. At one performance two important men grasped the ends of the cane and danced around the performer, who still had the rest of the cane down his throat.

Feeding of Trout in Tasmania. The study of the more important insects which serve as food for trout is an ind spensable preliminary to a full understanding of the methods by which a successful and permanent trout fishery may be maintained. Dr. R. J. Tillyard begins this study with reference to Tasmania with a description of the life-history and contacts of the mayfly genus, *Atalophlebia* (*Papers and Proc. Roy. Soc. Tasmania for 1933*, 1934, p. 1). He makes the interesting suggestion that the supply of these mayflies in the Macquarie River might be augmented by the judicious placing of more or less decayed timber in the stream. If old willows or gum-trees which are being cleared away near the river are cut into convenient lengths and submerged (in places where they would not interfere with angling), the mayfly nymphs find their way to these logs in vast numbers, and hiding in the crevices obtain a rich living from the vegetable material which collects on them and from the products of their decay. In the experience of the writer of this note, success on similar lines has followed upon the introduction of cut grass to a pond in the lowlands of Scotland.

Littoral Fauna of Hong Kong. In the *Hong Kong Naturalist* (Supp. No. 3, February 1934) there are four interesting papers dealing with the local fauna, namely: echinoderms by Th. Mortensen; holothurians by S. Heding; fishes collected in October–December 1931 by Albert W. Herre; and crabs (Part 4) by Chia- Jui Shen. A number (30 species in all) of Asteroids, Ophiuroids, Echinoidea, Holothuroids and Crinoids are recorded. This is the first time the echinoderm fauna of the vicinity of Hong Kong has been specially investigated, but the present collection only represents a small fraction of what is present in the area. Prof. Mortensen states that it is beyond doubt that more extensive shore collecting and dredging both in the littoral regions and in deeper waters will yield a very rich harvest. Three new species (one asteroid and two ophiuroids) are represented in the collections sent to him by Dr. Herklots, reader in biology in the University of Hong Kong, besides seven species new to the area, and included in the new species is a magnificent *Euryale* (*E. purpurea*, Mrtsn.) about 50 mm. in disc diameter. Among the holothurians are two new species and one new variety.

Iso-electric Points of Bacterial Suspensions. It has been shown in a number of cases that the presence of a salt affects the physical properties of proteins when these are studied in relation to changing hydrogen ion concentration. It is now found by G. Yamaha and S. Abe (*Sci. Reports Tokyo Bunrika Daigaku*, 1, 221; 1934), that similar effects may exist for suspensions of bacteria, of which nine species were used. The bacteria were suspended in a 0·9 per cent sodium chloride solution and the hydrogen ion concentration changed by the addition of hydrochloric acid. In these circumstances, the apparent iso-electric point as measured by precipitation was consistently at a much lower *p*H value than that found by cataphoresis. There is some evidence that this effect varies with the nature of the acid employed.

Genetics at Cold Spring Harbor. The Year Book, No. 32, of the Carnegie Institution of Washington for 1933 contains a report of the Department of Genetics by the director, Dr. C. B. Davenport. It refers to work done mainly at the Cold Spring Harbor Laboratory. By intensive investigation of the ten known allelomorphs of the miniature wing locus in *Drosophila virilis* and the eleven allelomorphs of white eye in *D. melanogaster*, Demerec is further analysing the nature of the gene. He has devised a method for testing whether a lethal factor at a particular locus is due to the elimination (deficiency) of the corresponding gene, and finds that 56 per cent of all lethals are cell lethals, the individual cell failing to survive in their absence. In *Datura*, Blakeslee has obtained several haploids with an extra chromosome, the extra being identified by the characters of the plant. He finds that segmental interchange has accompanied the production of new species in this genus. A mutation has been found which produces pollen dyads having $2n$ chromosomes. When selfed, the offspring are tetraploids and again form dyad pollen grains. Other extensive fields of investigation are leukemia in mice, another hormone of the anterior pituitary by Riddle, the inheritance of racing capacity and a general formula of heredity by Laughlin. Human genetics is represented by the studies of Steggerda and others on racial differences between Indians, Negroes and Dutch, the

papillary patterns of various races, growth studies of children, and the inheritance of sporadic goitre. Dr. T. Kemp suggests that this is due to a dominant gene in the X-chromosome which also causes non-disjunction of the two X-chromosomes in the female.

Polynesian Mosses. Edwin B. Bartram has recently published a report of a representative series of mosses collected by various travellers during the past ten years in the Society Islands, Austral Islands, Tuamotu Archipelago, Marquesas Islands, Cook Island, and Tonga (Bernice P. Bishop Museum Occasional Papers, 10, (10), 1–28; 1933). A considerable extension of the known range of several is noted and the following twelve new species are described and figured, the types being deposited at the Museum: *Dicranoloma plicatum*, *Calymperes tuamotuense*, *Calymperes pseudopodianum*, *Trichosteleum pygmaeum*, *Dicranella rufiseta*, *Dicranoloma brevifolium*, *Taxithelium falcifolium*, *Calymperes Quaylei*, *Thuidium ramosissimum*, Dixon and Bartram, *Raphidorrhynchium Quaylei*, *Glossadelphus tahitensis*, *Spiridens armatus*.

Treatment of Light Soils. Conference Report No. 17 from the Rothamsted Experimental Station, Harpenden, Herts (34 pages, price 2*s*., obtainable from the Secretary), deals with the difficult problem of the cultivation of the light soils of England. Successful methods of farming light hill arable and downland in Wiltshire are described by Mr. A. J. Hosier (Marlborough). Hoof cultivation and manuring the grass through dairy cows and poultry is the key to the improvement of his downland pastures. Improved grassland may then have its fertility cashed by a few years under arable cultivation. The results following the deep ploughing of thin acid sand resting on the chalk are set out by Mr. W. Parker (King's Lynn). Sugar beet growing becomes possible and the whole level of the rotation is raised. The utilisation of this land for the large-scale production of dried lucerne meal is a novel feature of Mr. Parker's system. Methods adopted by Mr. A. W. Oldershaw with much success in handling the acid sand at Tunstall, Suffolk, are fully discussed in his paper. They include deep cultivation, chalking and the use of suitable artificials. Finally, some of the scientific problems arising in the cropping of light soils are dealt with by Dr. H. H. Mann in the light of the classical field experiments conducted on the sandy soils of Woburn. The report shows that the difficulties of the management of the light soils can be met by capable and resourceful cultivators making full use of the scientific and technical methods now available.

Seismometric Reports on Tokyo Earthquakes. Since the great Japanese earthquake of 1923, nine seismograph stations have been established in the district round Tokyo, in addition to eight local meteorological observatories also provided with instruments. During the last three years, quarterly lists of the earthquakes sensible in Tokyo have been issued by the Earthquake Research Institute, each illustrated by a map showing the positions of the epicentres. Early this year, the lists for the years 1924–30 have been published in a special *Seismometrical Report*. In these seven years, the number of earthquakes felt in Tokyo is 413, or an average of 59 a year. In addition to the usual elements of the motion, the position of the epicentre is given for each earthquake and, in about three fourths of the total number, the depth of the focus. This ranges from 10 km. to 140 km., with an average of 42 km. or 26 miles. For each year, a map is added showing the distribution of the epicentres.

Electric and Photometric Units. Volume 15 of the *Procès-Verbaux* of the Comité International des Poids et Mesures contains the Report for 1933 of the Advisory Committee on Electricity and Photometry. With regard to electrical units, the Advisory Committee recommends that so soon as the results of the comparisons of the current international units with the absolute units have been made by all the national laboratories, the absolute units be substituted for the international. The question of adopting platinum instead of manganin as the material for standard resistances was left undecided. Some uncertainty as to the stability of the 12·5 per cent cadmium amalgum of the standard cell, and as to the utility of acidifying the cell, having arisen, the two questions were submitted to the national laboratories for investigation. Both resistance and electromotive force standards are to be determined to one part in a million. The primary unit of light intensity is ultimately to be based on the radiation from a perfectly black body, and in the opinion of the Advisory Committee, photometry of coloured lights can only be secured by fixing *a priori* a curve of visibility throughout the spectrum such as that recommended by the International Committee on Lighting in 1924.

Evaporated Metal Mirrors. R. C. Williams in a letter (*Phys. Rev.*, July 15) has described the advantages of making mirrors by evaporating on to glass first a thin film of chromium and then a layer of aluminium. The film is at first fairly soft, but it is hardened by washing in water or alcohol and may then be rubbed hard with cotton cloth without appreciable change. Even rubbing with steel wool affects the film only slightly. The reflectivity of the films is similar to that of pure aluminium. The aluminium may be dissolved off without affecting the chromium, and the author says he has found a method of removing the chromium layer if required.

Indium. A considerable amount of attention has been given in recent years to the so-called 'rare elements', several of which could be made available in quantity if a demand arose. A large field of chemical investigation is awaiting attention in this direction, and the old-fashioned attitude towards inorganic chemistry is rapidly passing away. An element which has in the past provided some important results from the point of view of chemical theory is indium. Its three chlorides, $InCl$, $InCl_2$ and $InCl_3$, disposed of the cherished doctrine of perissads and artiads, the very name of which is now practically unknown. The correct choice of the atomic weight of the element was one of the first services rendered to chemistry by the periodic law of Mendeléeff. A "Bibliography of Indium", drawn up by Potratz and Ekeley, has just been published by the University of Colorado (*Studies*, 21, No. 3; 1934), in which communications to the literature from the date of the discovery of the metal in 1863 to 1933 are listed in a classified system. Most of the work on indium appears to have been published in Germany and the United States, although England is represented by the work of Carpenter and Tamura on twinned metallic crystals, older work of Roberts-Austin and Carnelly, and an investigation of indium acetylacetone by Morgan and Drew.

Measuring Rate of Evaporation

By Dr. J. S. Owens

A NEW apparatus for measuring evaporation is shown in Fig. 1. A pan A contains the material from which evaporation is to be measured; this may be sand, soil, grass, water or other material. The pan A is supplied with water through a perforated tube C from a graduated glass tube E, which acts as a reservoir. The supply is so arranged that the level of the water table in the pan A is maintained constant, while the water required to do this is measured on the glass tube E, in millimetres of depth over the pan A. Thus, if the pan has a diameter of 10 cm. and the tube E, 2 cm., 1 mm. over the area of the pan will mean 25 mm. change of level in the tube. The pan may be of any convenient size to suit the desired conditions, and the bore of the tube E will then determine the magnification.

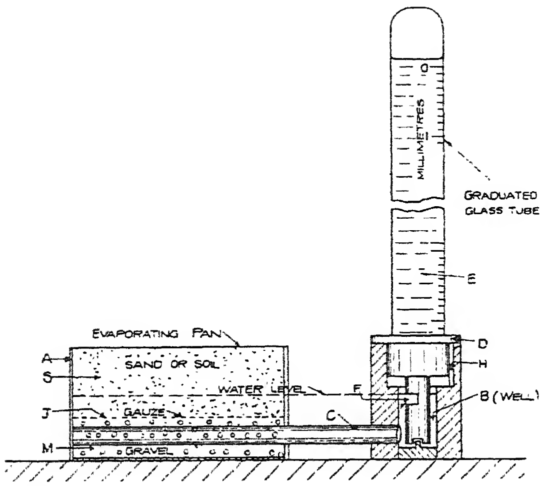

FIG. 1. Evaporating pan A, sand in pan S, gauze J, gravel M, connecting tube C, well B, port for air and water F, air channels H, socket of glass tube D, graduated tube E.

This is the basic principle of the apparatus and it is put into operation thus: the tube E is fixed in a socket D which fits into the top of the well B widened for the purpose. The socket D is prolonged downwards into the well B by a smaller tube, about 1 cm. bore. This prolongation is formed of two thin-walled tubes, one of which fits outside the other. The outer of these is closed at the bottom and has a slot, like in a wood screw, across its bottom.

The inner tube is open below. A port F is cut through the walls of both these, so that if the outer tube be turned round over the inner, the port F can be opened or closed. A projection on the floor of the well which engages in the slot in the bottom of the outer tube permits F to be opened or closed, while the graduated tube E is in position on the well.

Starting now with no water in the instrument and the pan A full of sand, the graduated tube is lifted out of the well. The outer tube or sleeve on the bottom projection is drawn off and the glass tube filled through the open end of the inner tube. The outer tube is pushed on over the inner and turned to close F, after which the glass tube is replaced in the well, turned to open F, when the water will run out and into the pan, bubbles of air entering through F. Air is admitted to the well by three vertical channels H round socket D. As soon as the water level reaches the top of F, no air can enter and the level remains fixed at this. If evaporation from the pan lowers the water in the well B, air is allowed to enter through F until the level is restored; thus a constant level is maintained. When starting, water may be put direct into the well until the sand is saturated and the water just covers the mouth of tube C in the well; the rest can be added as above.

After evaporation has gone on for some time and the tube E is nearly empty, it may be refilled by turning in its socket through 180° to close F, lifting out, removing outer sleeve and filling the tube. F is again closed by turning the outer sleeve, the tube E replaced gently in well, turned through 180° to open F, when the measurement can be continued without interruption. When measuring evaporation, the instrument should be on a level base and must not be moved, or if this is necessary, the opening F must first be closed and not opened until after moving and placing on a level bed. If this is not done, water may run from well to pan and admit air to the tube E.

Fig. 2 shows results obtained with this apparatus.

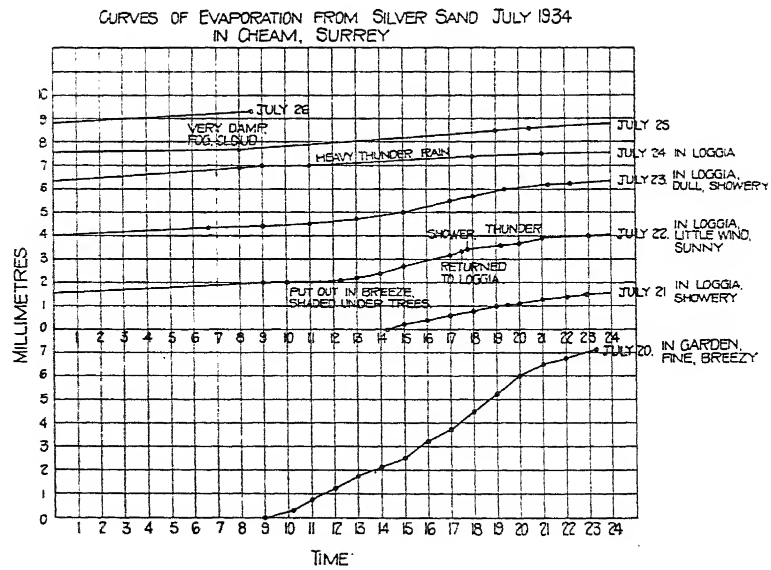

FIG. 2.

Evaporation, when rapid, can be measured over very short periods. The nature of the surface can be varied, also the material may be loose or compact. The effect of depth of water table from surface can be investigated by raising the pan or by adding loose rings; much other useful information, not hitherto easily obtainable, may be gained.

Chemistry of Photosynthesis

IN his presidential address to the tenth annual general meeting of the Indian Chemical Society held at Bombay, Prof. N. R. Dhar discussed some aspects of the chemistry of photosynthesis ("Chemical Aspects of Carbon Assimilation", *J. Indian Chem. Soc.*, 11, 145; 1934). Numerous experiments carried on in his laboratory during the past ten years show that formaldehyde is synthesised and detected when dilute solutions (5 per cent) of bicarbonates of the alkali metals are exposed to sunlight for about four hours in thin layers (0·5 cm. thick) either in open dishes or covered with silica plates at temperatures up to 30°; higher temperatures are prejudicial to formaldehyde formation. The amount of formaldehyde photosynthesised per 100 c.c. of solution exposed is 0·00007–0·0001 gm. Schryver's reagent is most sensitive for the detection of formaldehyde in small quantities. The amount of formaldehyde obtained by exposing the bicarbonate solutions in the same dishes placed in a bath at 40° is about one third of that obtained at 30° under identical conditions.

It is interesting to note that in Nature the amount of carbon assimilation is less at 40° than at 30°. Moreover, the amount of formaldehyde in rain-water obtained after a succession of bright days is practically the same as is photosynthesised by exposing potassium bicarbonate solutions to sunlight. Larger amounts of formaldehyde are produced by the reduction of bicarbonate or carbonic acid solutions by metallic cerium, tungsten, iron, etc. This reduction is accelerated by light. These results have been confirmed by Mezzadroli and his collaborators (1927–29) and very recently by Yoe and Wingard (*J. Chem. Phys.*, 1, 886; 1933).

Reducing sugars have been obtained by exposing formaldehyde solutions to sunlight mixed with ferric chloride. The temperature coefficient for this reaction for a 10° rise of temperature is of the same order as that of the photosynthesis with *Elodea* or *Hydrilla*.

When solutions of glycol and potassium nitrate are exposed to sunlight for 8 hours in presence of titanium oxide as a photocatalyst, glycine is produced. Similarly, a solution containing glucose and potassium nitrate with titanium oxide, when exposed to sunlight for the same period, appears to produce arginine amongst other substances. Longer exposure to light causes the disappearance of the amino acids photosynthesised, probably due to their photo-oxidation. Solutions of ammonium lactate also form amino acids on exposure to light. The amino acids thus obtained can be readily detected by the valuable 'ninhydrin' test.

The temperature coefficients of photosynthesis in plants do not obey the Arrhenius relation connecting the temperature and the velocity of a reaction. In photosynthesis, the observed values of temperature coefficients are always smaller than the calculated ones. The phenomenon of 'solarisation', or the adverse effect of strong light on photosynthesis, and the fact that the compensation point, that is, the light intensity at which the photosynthetic and respiratory activities of the plant compensate each other, decreases with fall of temperature. The non-applicability of the Arrhenius relation to photosynthesis has been explained on the following considerations :—

(*a*) Photosynthesis is proportional to the light intensity.

(*b*) Respiration takes place in the dark but is appreciably accelerated by light.

(*c*) An increase of temperature enhances respiration more markedly than photosynthesis.

Moreover, the smaller temperature coefficient of photosynthesis in feeble than in intense light and the lower temperature coefficient in chlorophyll-poor leaves in comparison with chlorophyll-rich leaves have also been explained from the same viewpoint.

A new theory of carbon assimilation is also advanced in which the following are the main points :

(1) Partial activation of carbon dioxide and water at the leaf surface due to their adsorption by chlorophyll and other pigments. It seems that chlorophyll and carotinoids act as photo-sensitisers, and as reducing agents in the photo-reduction of carbon dioxide.

(2) Further activation of the adsorbed carbon dioxide and water by absorption of a part of the energy available from respiration and oxidation of carotin, and the formation of activated carbon dioxide and water as products of respiration.

(3) Absorption of light by chlorophyll and other pigments and the dissociation of the activated water molecules, on the leaf surface, into H and OH_1, and the reduction of activated carbon dioxide into formaldehyde by the atomic hydrogen produced from the sensitised photolysis of water. The amount of energy required to decompose a gm. mol. of water into H and OH is practically the same as that necessary for the formation of a gm. mol. of formaldehyde from carbon dioxide and water.

(4) Polymerisation of formaldehyde to reducing sugars.

(5) The formation of hydrogen peroxide from OH and the rapid decomposition of hydrogen peroxide into water and oxygen on the leaf surface. Formaldehyde is obtained more readily by the photo-oxidation of energy-rich compounds than by exposing bicarbonate solutions to light.

There is an intimate relation between respiration and photosynthesis in the plant kingdom. It seems that photosynthesis cannot proceed without the energy available from respiration for the partial activation of carbon dioxide and water. The need of oxygen in photosynthesis is also easily explained. Experimental evidence in support of this theory of carbon assimilation was given.

Botanical Work in the University of Lucknow

THE University of Lucknow Department of Botany issues a small pamphlet which contains abstracts of the published work of the Department in the quinquennium 1928–32. This report makes it clear that the contributions of this Department, under the guidance of Prof. Birbal Sahni, have been very valuable in nature and cover such a wide field of botanical activity that the senior students of the Department should readily find both inspiration and guidance whatever special interest may determine the approach to their botanical problems.

Prof. Sahni himself is represented by a long series

of papers most of which deal with palæobotanical problems, often of very wide general interest. Several papers deal with petioles and rhizomes of zygopterid affinity which tend to the conclusion that the "old and once extensive genus *Zygopteris*, after many vicissitudes, will probably emerge once more as the largest and most important of the Zygopterideæ". A solitary block of secondary wood found long ago at an unknown locality in the Rajmahal Hills, Bihar, has aroused Prof. Sahni's interest in the vessel-less Dicotyledons, as this wood, undoubtedly of Jurassic age, shows definite affinities with these plants. The block is put in a new genus *Homoxylon* and the wood of the living genus *Tetracentron* has been re-examined.

Dr. S. K. Mukerji has interesting papers upon salt distribution in soil (which leads to a re-examination of Liesegang rings) and upon ecological questions, together with a very forceful statement of the need for the compilation of an Indian pharmacopœia and of increased interest in the commercial plantation and exploitation of Indian medicinal plants. He has also several interesting papers upon the conditions governing the distribution of water plants in Indian freshwater areas.

Dr. H. P. Chowdhury has several papers upon the factors affecting respiration and transpiration in apple fruits, which record several attempts to determine cell size and the comparative extent of intercellular space systems, very difficult variables to measure in such fleshy tissues. He has also papers on the algal and fungal vegetation, whilst Dr. S. K. Pande has several papers upon Indian liverworts. There are other contributions and other fields of work but this brief review of the contents of this pamphlet, published by the University of Lucknow (1933), shows what signal progress the Indian universities, guided by Indian investigators, are making in biological fields of work.

Photoelectric Theory and Applications

LIKE the thermionic valve, the photoelectric cell has evolved during recent years from an interesting scientific novelty into an instrument of everyday commercial application. In such circumstances a large amount of scientific and technical information is published, and the assimilation of this information presents some difficulty to those not actively engaged in the particular field concerned. A useful paper in this connexion was presented to the Television Society on February 14, entitled "Review of the Theory and Applications of Photoelectric Effects" by G. Windred. This paper constitutes a summary of our present knowledge of photoelectric phenomena, with a brief outline of the relevant theory and an indication of some of the applications of modern photoelectric cells.

Treating the subject in historical order, reference is made to the photo-conductivity effect exhibited particularly by selenium. It is shown that the change in conductivity of this substance is proportional to the square root of the energy in the incident light. By suitable construction, a selenium cell may be made to give a current change of 100 milliamperes between dark and light conditions, and in this form it is used to operate relays for a variety of purposes. The selenium bridge has also played an important part in the transmission of sound by light as in the photophone. For many purposes, however, the selenium cell has been eclipsed by the photoelectric cell, which incorporates a substance which liberates electrons under the influence of incident light. The energy of the emitted electrons is proportional to that of the incident light, and the phenomenon is thus exhibited particularly at short wave-lengths.

One form of the modern photoelectric cell employs a cathode with a monomolecular film of potassium or cæsium on oxidised silver in an atmosphere of argon. An alternative form of photoelectric cell has been developed from the copper oxide rectifier; this cell consists of a layer of cuprous oxide on a copper plate forming one electrode, while a conducting gauze is placed in contact with the oxide to form the second electrode. In the latter case, illumination of the oxide surface through the gauze results in the production of electrons which flow from the oxide to copper and produce a current in the external circuit without the aid of a battery or other source of electromotive force. Both these types of photoelectric cell are in widespread use for many scientific and technical purposes, such as photometry, sound films and television.

Radio Research in Great Britain

SINCE its establishment in 1920 under the Department of Scientific and Industrial Research, the Radio Research Board has contributed notably to the study of many problems which have arisen in connexion with the science and practice of radio communication. At suitable stages in the course of each investigation, the results are made available either by the issue of special reports through H.M. Stationery Office or by the publication of papers in the proceedings of scientific and technical societies. In addition, summaries of the work are published periodically in the form of Reports of the Radio Research Board, the latest of which covers the period January 1, 1932, to September 30, 1933.*

The date at which an account of the work for the year 1932 would normally have been submitted found the organisation of the Radio Research Board in a state of transition, and the publication of the report under review was therefore intentionally delayed in order that the introduction and first results of two notable improvements in organisation might be dealt with in some detail. These relate to the complete re-organisation of the Committees generally supervising the work of the Board, and the amalgamation of the Wireless Division of the National Physical Laboratory and the Radio Research Station, Slough, into a new Radio Department of the Laboratory. An additional advantage of the delay is that substantial progress is reported in several investigations which had reached only a very preliminary stage at the end of 1932.

A considerable portion of the report is devoted to investigations on the propagation of electric waves, and particular attention is given to the development and utilisation of new methods of 'echo-sounding'

* Department of Scientific and Industrial Research. Report of the Radio Research Board for the period 1st January 1932 to 30th September 1933. Pp. iv+137. (London: H.M. Stationery Office, 1934.) 2*s*. 6*d*. net.

of the ionosphere, by which observers on the ground can explore the electrical condition of the atmosphere at heights of 60–150 miles. A preliminary account is given also of the results obtained from the special work carried out during the Second International Polar Year, which covered the thirteen months ended in August 1932. Closely associated with the research on wave propagation has been the study of the angle of incidence and of the varying intensity and polarisation of waves received from distant transmitting stations; while, in another sphere of activity, the development of a practical radio direction-finder which shall be immune from the effects of these varying electric waves, has been continued with considerable success. Attention has also been devoted to the production and study of short electric waves down to wave-lengths of about 15 cm., and to their mode of propagation over the earth's surface. Work which is more of a laboratory rather than field nature has included the maintenance and development of the radio frequency standards at the National Physical Laboratory, and of the methods of measuring various electrical quantities used in radio technique. A new wireless transmitter of somewhat unique design has been installed at the Laboratory during the period under review; while a special investigation was conducted into the problem of interference and receiver selectivity. Finally, the report describes the latest developments made at the Radio Research Station in connexion with the cathode ray oscillograph.

The serious student and expert worker in radio research problems will find much to interest him in the report, while access to more detailed information on the subject is facilitated by the list given in an appendix of publications describing the work of the Radio Research Board during the period under review.

Science News a Century Ago

Death of Telford

Thomas Telford, the first president of the Institution of Civil Engineers, died at his house, 24 Abingdon Street, Westminster, on September 2, 1834, at the age of seventy-seven years. In an obituary of him published in the *Annual Register* for 1834, it is said that "he was inclined to set a higher value on the success which attended his exertions for improving the great communication from London to Holyhead, the alterations of the line of the road, its smoothness, and the excellence of its bridges, than on the success of any other work he executed. . . . He understood algebra well, but held mathematical investigation rather cheap, and always resorted to experiment when practicable, to determine the relative value of any plans on which it was his business to decide. . . . Mr. Telford's will was sworn under £35,000. The testator bequeaths about £3,000 to divers charitable institutions, and legacies to several persons of mechanical and literary genius, amounting altogether to £16,000. Among these is a bequest of 500 guineas to Robert Southey, esq., the poet laureate."

Botanical and Horticultural Shows

It was the custom of J. C. Loudon, the editor of the *Gardener's Magazine*, to collect and print in his journal, after midsummer, a comprehensive series of reports and notices of the provincial flower shows and kindred exhibitions held in England and in Scottish centres. These were of special importance at the period to cultivators of new plants and shrubs, as well as of great benefit to gardeners and the community in regard to displays of fruit and vegetables. The Beverley Floral and Horticultural Society promoted a gathering of this kind on September 3, 1834, the details of which appeared in the *Hull Advertiser*. Reference was made to a "brilliant assortment of georginas", the latter term being then in common use. It seems that the president of the Beverley Exhibition took occasion to protest against the adoption of the name *Georgina* in place of *Dahlia*. This led Loudon to write as follows: "The genus was named Dahlia in honour of Prof. Dahl a Swedish botanist. Objections were at first made to this name under the erroneous impression that it had already been appropriated to another genus, and this induced Prof. Willdenow in his 'Species Plantarum' to apply a new name, that of Georgina, after Georgi, an eminent Russian traveller and botanist. Mr. David Don has proved to us that the name Dahlia was applied one year before that of Georgina, and that therefore, although the latter name has been adopted in the 'Dictionnaire d'Histoire Naturelle', the former ought to be retained." Loudon then states that it is his intention to use the name *Dahlia* in all future issues of his publication. (*Gardener's Magazine*, 1834.)

The Post Office Steam Packet Service

In the 'twenties of last century, the old sailing packets between England and Ireland and the Continent were superseded by steam vessels, but the mail steamers still continued to be run directly by the Post Office. In a note in the *Mechanic's Magazine* of September 6, 1834, it is stated that "The Post Office has now twenty-four steam vessels regularly employed in its service; four between Liverpool and Dublin, of about 300 tons each, and 140 horses' power; six between Holyhead and Dublin, of 235 tons and 100 horses' power; four between Milford and Waterford of from 189 to 237 tons, and 80 horses' power; two between Port Patrick and Donaghadee of 110 and 130 tons, and 40 horses' power; three between Weymouth and Guernsey and Jersey of from 154 to 165 tons and 60 horses' power; and five from Dover to Calais and Ostend, of 110 tons each and 40 and 50 horses' power. They perform 2,293 voyages annually."

The Pulkova Observatory

The suggestion for the construction of an observatory near St. Petersburg was made by the Emperor Nicholas I (1796–1855) in 1830. In the *Athenæum* of September 6, 1834, it was said: "A new observatory, far surpassing in magnitude every similar establishment is about to be built at St. Petersburg by command of the Emperor. The observatory itself will consist of three towers with moveable cupolas. Two of these towers are to be appropriated to the Königsberg heliometer and the Dorpat refractor, but the centre tower is destined for the reception of an instrument exceeding in size all others of its kind. In the lower part of the towers the meridian and transportable instruments will be placed. Spacious habitations for five astronomers will be connected by corridors with these towers so that the whole will form a continuous building 510 ft. in length. Smaller subordinate buildings, for various purposes, will increase the establishment, for the site of which an eminence between six and seven miles from St. Petersburg has been selected." The foundation stone of the famous observatory was laid on June 21, 1835, and the building was completed on August 19, 1839.

Societies and Academies

DUBLIN

Royal Dublin Society, June 26. J. CARROLL: Potato eelworm (*Heterodera Schachtii*) investigations. Work on the potato eelworm has established the fact that the root excretion of potatoes growing in recently sterilised soil does not possess the power of inducing hatching of eelworm eggs in the normal manner. J. REILLY and DENIS F. KELLY: A note on fatty oil production. Consideration is given to the possibilities of the economic production of various vegetable oils from seeds such as flax, hemp, rape, sunflower, soya bean, poppy, mustard and mercuriales, in the Irish Free State. J. J. RYAN and G. T. PYNE: Investigations on the cryoscopy of milk. A cryoscopic constant is developed for milk based on estimations of refractive index, chlorides and soluble phosphates, which allows of close approximation to the freezing point. Results of tests on some 40 samples of (mainly) individual milks showed close agreement between the two. It is suggested that the determination may prove useful for the detection of watering, particularly where the refractive index is already in use for sorting purposes. J. LYONS and M. O'SHEA: The influence of the stage of lactation on fat estimations by the Gerber method. Because of the increase in the proportion of small fat globules in milk as lactation advances, a modification of the Gerber method of determining fat percentage is necessary. M. J. GORMAN and D. SLATTERY: Some observations on the influence of lime on the growth of red clover in an acid soil. Red clover (broad, late flowering and wild) was grown in pots in an acid (pH5) soil to which sufficient lime was added to raise the pH to 6·5. Compared with controls which received no lime, the plants in the limed series at the end of eighteen weeks were smaller and yielded less dry matter; their fibrous roots were poorly developed and nodules were few or absent. In the unlimed pots, fibrous roots were well developed and nodules were abundant.

PARIS

Academy of Sciences, July 9 (*C.R.*, 199, 105–172). The president announced the deaths of Mme. Curie and of Benjamin Baillaud. K. BOTSUK and S. MAZURKIEWICZ: Absolute *rétractes*, not admitting decomposition. GEORGES KUREPA: Branched tables of ensembles. MIRON NICOLESCO: The representation of continued functions of several variables by uniformly convergent series of polyharmonic functions. A. KULAKOFF: Burnside's problem. ROBERT LÉVI: Rolling with slipping. F. E. MYARD: A gearing with inclined axes. JEAN BAURAND: The propagation of a train of periodic waves at the surface of water. HENRI SUBRA: A method of measuring static voltages such as the voltage of charge of a condenser, in the case of voltages higher than 0·1 volt and with the aid of a transportable apparatus utilising a voltmeter as the only measuring instrument. STEPHEN PROCOPIU: The ideal magnetisation of a crystal of iron. MAURICE FALLOT: The iron-platinum alloys. The Curie point and magnetic moments. GEORGES LIANDRAT: The photoelectric emission of the boundary layers and Einstein's relation. R. BOSSUET: Researches on the alkaline metals in natural waters. Results of the application of spectrographic methods. Waters from the primitive formations are characterised by the presence of the five alkaline metals and those from superficial strata by the absence of lithium. The wide distribution of rubidium is noteworthy. HERSZFINKIEL and A. WRONCBERG: The radioactivity of samarium. Employing the method of direct measurement of the ionisation current, and taking special precautions to reduce the amount of possible radioactive impurities, the range of particles observed was slightly higher than the 1·5 cm. found by Curie and Joliot. JULES GUÉRON: Variation of the light diffusing power and of the viscosity of solutions of stannic chloride in the course of their evolution. MARCEL GUICHARD: The study of chemical systems by variation of weight with regularly varying temperature. Discussion of the interpretation of weight-time curves obtained by the method previously described by the author. HENRI MURAOUR and W. SCHUMACHER: The study of the propagation of explosive decomposition in a mercury pump vacuum. Details of experiments with iodide of nitrogen, hexamethylenetetramine peroxide and hexogen. E. ARENDT: The internal corrosion of zinc. JAMES BASSET: The preparation of crystallised carbon under very high pressure. Under very varied physical and chemical conditions and under pressures reaching 25,000 kgm./cm.^{2}, the carbon is always obtained as graphite. PAUL LAFFITTE and J. BRETON: The detonation limits of some gaseous mixtures. The inflammation limits of a large number of gas mixtures have been determined, but very few determinations have been made of the detonation limits, that is, the limits between which a gas mixture can give an explosive wave. Details of experiments with hydrogen-air, hydrogen-oxygen, hydrogen and carbon monoxide-air, hydrogen and carbon monoxide-oxygen mixtures are given. JEAN DESMAROUX: The fixation of acetone by nitrocellulose. RAYMOND QUELET: A method of synthetic preparation of α-chlorethyl derivatives of the phenol oxide ethers: application to the synthesis of some vinylanisols. MLLE. BLANCHE GRÉDY: The preparation of some acetylene compounds of the cyclane series. P. P. AREND: Relations between the original structure of the disperse phase of natural soils and the crystalline and metasomatic transformation of the sediments. JEAN GOGUEL: The tectonic of the region situated to the north of Grasse. CH. POISSON The polar front and the formation of typhoons. M. DOUGUET and R. BUREAU: The diurnal variation of atmospherics during the polar night. Discussion of records of atmospherics obtained at the French station at Scoresby Sound. PIERRE CHOUARD: A singular case of the transformation of bulbs into rhizomes throwing up shoots. MLLE. N. CHOUCROUN and HARRY PLOTZ: The differences between the electrifications of various varieties of the tubercle bacillus. The experiments described point to a greater electrification when the virulence is greater. IWO LOMINSKI: The action at a distance of the staphylococcic bacteriophage on the staphylococcus. EMILE ROUBAUD and JEAN MEZGER: The sensibility to bird malaria (*Plasmodium relictum*) of various racial swarms of the common mosquito, *Culex pipiens*.

CAPE TOWN

Royal Society of South Africa, March 21. E. C. CHUBB, G. BURNHAM KING and A. O. D. MOGG: A new variation of Smithfield culture from a cave on the Pondoland Coast. A description of the excavation of a cave at the mouth of the Umgazana River,

some ten miles south-west of Port St. John's. Pottery was found in the later layers, and stone implements in all the occupational strata. There can be no doubt that the congeries is assignable to the Smithfield culture, but shows a variation from the typical congeries of this division from open sites. T. F. DREYER: The stratification of the superficial deposits at Mossel Bay and the age of the Mossel Bay and other lithic industries. A. P. GOOSSENS: An anatomical study of the roots of grasses. The development of the root and its tissues is discussed. Root hairs occur all over the whole length of the root, and usually become cemented to the soil particles, to form a sheath. A perforated cortex is a characteristic feature of grass roots, and seems to be associated with a better oxygen supply. The stele of grass roots varies very little. The pith is important in that reserve food is stored in it during the resting period. MARGARET ORFORD: Neolithic stone implements found at Regina in the western Transvaal. The two specimens described afford additional evidence of the presence of a highly developed Neolithic culture in South Africa. The association of Smithfield rings and Neolithic daggers proves the existence of a definite link between these industries. A tentative suggestion as to the contemporaneity of the Neolithic and Bronze Ages in South Africa has before been put forward. The style and finish which these objects present suggests the possibility of their being copies of Bronze objects. The material of which they are composed was used in the construction of ornamental objects from the Zimbabwe culture. We may say, therefore, that these specimens form a link between the Neolithic, Smithfield and Zimbabwe industries. J. M. WINTERBOTTOM: Bird population studies (5). An analysis of the avifauna of the Jeans School Station, Mazabuka, Northern Rhodesia. M. A. KEAY: Water absorption by leaves of *Crassula*.

LENINGRAD

Academy of Sciences, *C.R.*, n.s., 2, No. 2. A. WALTER and L. INGE: The influence of the concentration of electrons on the dielectric resistance of crystals. I. KIKOIN: A new photoelectric effect in cuprous oxide. Supplementary data to the communication published in NATURE of May 20, 1933, p. 725. D. BLOKHINTSEV: Contribution to the theory of phosphorescence. I. N. NAZAROV: Dehydration of the tertiary-butyl-tertiary-heptyl-carbinols. R. I. BELKIN: Studies on the regeneration in Amphibia (2). Influence of the temperature on regeneration in the axolotl (3). Regeneration of parts of extremities implanted into the tail of the axolotl. G. A. NADSON and E. A. STERN: New observations on the biological action of metals at a distance. Metals, acting at a distance, can retard the development not only of micro-organisms, but also of germinating seeds, the energy of the action being in proportion to the atomic weight of the metal. E. HASRATIAN: The influence of extraneous and conditioned stimuli upon an unconditioned food reflex. M. SHKOLNIK: The effect of boron upon the development of flax in water and soil cultures. The author's experiments proved the complete inability of flax to develop in the absence of boron. In soil cultures a substantial increase of yield was obtained by fertilising the soil with boron. I. KOLOMIEC: On drought resistance and its outward signs in different varieties of spring wheat. The water content and the degree of drought resistance in each variety is not constant, but depends on the stage of growth. A. I. OPARIN: Metabolism in sugar beet at low temperatures and the storage of beet in a frozen state. In a root killed by frost, the biochemical processes connected with the disintegration of sucrose ceased immediately, and such roots may be preserved for any length of time, provided the temperature remains below $-3 \cdot 5°$ C. The method has been applied on a commercial scale. V. FOMITCHEV: Devonian deposits of the periphery of the Kuznetsk Basin. N. KUZNETSOV-UGAMSKIJ: Movements of the coast-line of the Issyk-Kul lake. G. VERESCHAGIN, A. GORBOV and I. MENDELEJEV: Contribution to the problem of the occurrence in Nature of water with anomalous density. It is suggested that the preservation of the ancient fauna in Lakes Baikal and Tanganyika may be due to their exceptional depths and the presence of 'heavy' water. The necessity of studying the properties of various natural waters is pointed out. K. K. FLEROV: Geographical distribution and systematics of the elk or moose (*Alces*, Gray). Two species are recognised, namely, *Alces alces*, L., occurring in Europe and in Western Siberia, and *A. americanus*, Clinton, of which three subspecies occur in North America, one in the Yakutsk region and one in the Ussuri region of Siberia.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 221–249, April 15, 1934). L. F. AUDRIETH and M. T. SCHMIDT: Fused 'onium' salts as acids. (1) Reactions in fused ammonium nitrate. Fused ammonium nitrate is a good conductor and contains the 'onium' ion, which in certain circumstances may lose a proton, giving the fused salt the properties of an acid. Similar 'onium' salts (ammonium, hydrazine, hydroxylamine, pyridine, aniline and phenylhydrazine compounds) can all act as acids in the fused and the dry states. This view has important applications in considering (1) the use of ammonium sulphate and fluoride as fluxes for ores, (2) certain reactions of metals, oxides and carbonates with ammonium salts, etc. It is based on Brønsted's view that acidity is a matter of competition between the solvent and the acid anion for the proton. E. M. EAST: Norms of pollen-tube growth in incompatible matings of self-sterile plants. The extent of the pollen-tube growth is regarded as conditioned by a type of chemical reaction similar to the specific protein reactions of immunology. L. C. DUNN: A new gene affecting behaviour and skeleton in the house mouse. Characters of the new type are shortened tail, erratic circus movements and complete deafness and sterility. It acts as a simple recessive to normal and is termed 'shaker-short' (st). J. W. GIVENS, JR.: Projective differentiation of spinors. B. F. SKINNER: The extinction of chained reflexes. In a chain of reflexes not ultimately reinforced, only the members actually elicited undergo extinction when the chain is interrupted. SELIG HECHT and AURIN M. CHASE: Anomalies in the absorption spectrum of visual purple. Certain workers have found evidence of the appearance of a yellow intermediate body in the bleaching of visual purple. The density of visual purple solutions obtained from the eyes of frogs kept in cold storage decreased steadily during bleaching when measured with light of wave-length 550 mμ; measured with light of wave-length 450 mμ, it first

rose and then fell, indicating formation of an intermediate compound. A solution of visual purple from active frogs in summer shows no such preliminary increase of absorption during bleaching. It is suggested that 'winter' and 'summer' frogs' visual purple contain different quantities of coloured or colourless substances which combine with decomposition products of visual purple to form a yellow substance. G. A. MILLER: Groups involving three and only three squares. W. M. ROGERS: Heterotopic spinal cord grafts in salamander embryos. Co-ordinated movements of the fore-limbs resulted only when the implanted graft included the normal brachial region of the cord, thus confirming earlier investigators' results. In addition, it was shown that the co-ordinating mechanism can develop in brachial cords isolated from the central nervous system previous to the outgrowth of nerves. Co-ordination reflexes are independent of the number of nerves which grow into a limb during development.

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (ABERDEEN MEETING)

Wednesday, September 5

At 8.30 p.m.—Sir James Jeans: "The New World-Picture of Modern Physics" (Presidential Address in the Capital Cinema, Union Street).

Thursday, September 6

At 10 a.m.—Prof. T. M. Lowry: "Physical Methods in Chemistry" (Presidential Address to Section B).

Dr. E. S. Russell: "The Study of Behaviour" (Presidential Address to Section D).

Prof. A. G. Ogilvie: "Co-operative Research in Geography and an African Example" (Presidential Address to Section E).

Prof. F. G. Baily: "Sources of Cheap Electric Power" (Presidential Address to Section G).

Prof. A. W. Borthwick: "Some Aspects of Forest Biology" (Presidential Address to Section K).

Mr. H. T. Tizard: "Science at the Universities: Some Problems of the Present and Future" (Presidential Address to Section L).

At 2 p.m.—Conference of Delegates of Corresponding Societies. Sir Henry Lyons: "Scientific Societies and Museums" (Presidential Address).

Friday, September 7

At 10 a.m.—Prof. H. M. MacDonald: "Theories of Light" (Presidential Address to Section A).

Prof. W. T. Gordon: "Plant Life and the Philosophy of Geology" (Presidential Address to Section C).

Prof. H. M. Hallsworth: "The Future of Rail Transport" (Presidential Address to Section F).

Dr. Shepherd Dawson: "Psychology and Social Problems" (Presidential Address to Section J).

At 8.30 p.m.—Sir Frank Smith: "Storage and Transport of Food" (Sir William Hardy Memorial Lecture) (MacRobert Hall, Gordon's College).

INSTITUTE OF METALS, September 3–6. Annual Autumn Meeting to be held at Manchester.

Sept. 3.—Dr. J. L. Haughton: "The Work of Walter Rosenhain" (Annual Autumn Lecture).

Official Publications Received

GREAT BRITAIN AND IRELAND

Ministry of Agriculture and Fisheries. Economic Series No. 40: Abattoir Design; Report of Technical Committee. Pp. 46+xii. (London: H.M. Stationery Office.) 1*s.* net.

The Strangeways Research Laboratory, Cambridge. Report for 1933. Pp. 24. (Cambridge.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1577 (T.3202 and S. and C. 548): Westland-Hill Pterodactyl Mark IV. Part 1: Experiments on One-fifth Scale Model, by A. S. Batson; Part 2: Full Scale Tests, by J. E. Serby. Pp. 19+16 plates. 1*s.* 6*d.* net. No. 1582 (S. and C. 565): Aileron Angles in High Speed Manœuvres with Single Seater Fighters. By B. V. Williams and J. H. Hartley. Pp. 8+6 plates. 6*d.* net. (London: H.M. Stationery Office.)

City of Leicester Museum and Art Gallery. Thirtieth Report to the City Council, 1st April 1933 to 31st March 1934. Pp. 30. (Leicester.)

The University of Leeds: Department of Coal Gas and Fuel Industries (with Metallurgy). Report of the Livesey Professor (John W. Cobb) for the Session 1932–33. Pp. 12. (Leeds.)

Mines Department. Twelfth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1933. Pp. 129+19 plates. (London: H.M. Stationery Office.) 2*s.* net.

Fifteenth Annual Report of the Ministry of Health, 1933–1934. (Cmd. 4664.) Pp. xii+388. (London: H.M. Stationery Office.) 6*s.* net.

Proceedings of the Royal Society of Edinburgh, Session 1933–1934. Vol. 54, Part 2, No. 14: Fifty Years Ago, in the Royal Society of Edinburgh. An Address delivered, at the request of the Council, on May 7, 1934, in commemoration of the 150th Year of the Society. By Prof. D'Arcy Wentworth Thompson. Pp. 145–157+2 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1*s.* 6*d.*

OTHER COUNTRIES

Canada: Department of Mines: Geological Survey. Summary Report 1933, Part B. (No. 2353.) Pp. 176B+2 plates. 50 cents. Summary Report 1933, Part D. (No. 2351). Pp. 162D+5 plates. 50 cents. Economic Geology Series, No. 13: Platinum and Allied Metal Deposits of Canada. By J. J. O'Neill and H. C. Gunning. (No. 2346.) Pp. 165. 50 cents. Memoir 172: Geology and Mineral Deposits of Salmo Map-area, British Columbia. By J. F. Walker. (No. 2345.) Pp. 102. 25 cents. (Ottawa: King's Printer.)

Canada: Department of Mines: National Museum of Canada. Bulletin No. 73: Annual Report for 1933. Pp. 30. (Ottawa: King's Printer.) 25 cents.

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 107: A Development of the Michell's Theory of Lubrication. By Torao Kobayashi. Pp. 385–414. 25 sen. No. 108: On the Effect of Pipe Bores on the Cut-off of Fuel Spray in Injection Systems with Open Nozzles. By Fujio Nakanishi, Masaharu Itô and Kikuo Kitamura. Pp. 415–435. 25 sen. (Tôkyô: Koseikai Publishing House.)

Entomological Investigations on the Spike Disease of Sandal. (23) Anthicidae (Col.). By Dr. Rudolf F. Heberdey. Pp. 14+1 plate. (Delhi: Manager of Publications.) 7 annas; 9*d.*

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 15, No. 3: Nematode Parasites of Mammals, from Specimens collected in the New York Zoological Park, 1932. By Gervase W. McClure. Pp. 49–60. (New York City.)

Harvard Meteorological Studies. No. 1: Daytime Radiation at Blue Hill Observatory in 1933, with Application to Turbidity in American Air Masses. By Bernhard Haurwitz. Pp. 31. (Cambridge, Mass.: Harvard University.) 50 cents.

Bulletin of the American Museum of Natural History. Vol. 66, Art 3: The Diptera of Kartabo, Bartica District, British Guiana. By C. H. Curran. Pp. 287–532. (New York City.)

The Cawthron Institute, Nelson, New Zealand. Thomas Cawthron Centenary Lecture, October 10th, 1933: The Achievements of the Cawthron Institute. By Dr. T. H. Easterfield. Pp. 19+5 plates. (Nelson.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Jaarverslag 1933. Pp. 27. (Batavia.)

Carnegie Institution of Washington. Publication No. 450: Diametral Changes in Tree Trunks. By Ferdinand W. Haasis. Pp. iii+103+4 plates. Publication No. 423: The Building of the Roman Aqueducts. By Esther Boise Van Deman. Pp. xi+440+60 plates. (Washington, D.C.: Carnegie Institution.)

Proceedings of the First Meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry held at New Delhi from the 20th to the 23rd February 1933; with Appendices. Pp. iii+297. (Delhi: Manager of Publications.) 5·14 rupees; 9*s.* 6*d.*

U.S. Department of the Interior: Office of Education. Pamphlet No. 48: Residence and Migration of College Students. By Frederick J. Kelly and Betty A. Patterson. Pp. 22. (Washington, D.C.: Government Printing Office.) 5 cents.

Memoirs of the Geological Survey of India. Vol. 65, Part 1: The Dhubri Earthquake of the 3rd July 1930. By E. R. Gee. Pp. vi+106+vi+11 plates. (Calcutta: Geological Survey of India; Delhi: Manager of Publications.) 4.6 rupees; 7*s.* 3*d.*

Forest Bulletin No. 83: Provisional Yield Table for *Quercus incana* Roxb. (Banj or Ban Oak.) By H. G. Champion and I. D. Mahendru. Pp. iv+13+3 plates. (Delhi: Manager of Publications.) 14 annas; 1*s.* 6*d.*

CATALOGUES

Shell Wild Barfield Quenching Oils. Pp. 16. (London: G. W. B. Electric Furnaces, Ltd.)

Zeiss Nachrichten. Heft 7, Juli. Pp. 43. (Jena and London: Carl Zeiss.)

SATURDAY, SEPTEMBER 8, 1934

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CONTENTS

The Philosophy of Sir James Jeans

It is commonly admitted that for some years past physical theory has exerted a predominating influence in general philosophic thought in Great Britain. It is a surprise, therefore, to learn that not for fifty years has a theoretical physicist presided over the British Association, and Sir James Jeans's graceful tribute to the late Sir William Hardy reminds us that even now it is partly by accident that the long period of exclusion has ended. Certainly the fact, which biologists rightly regret, that theoretical physics absorbs an excessive amount of the popular interest in science, cannot be ascribed to excessive opportunity for advertisement. In the circumstances Sir James has every justification for devoting the bulk of his address to the subject nearest his heart, the more so since the task fulfilled in the concluding paragraphs—which are, at best, an attempt to employ reason in a field where reason is particularly ineffective—can be regarded as little more than an acknowledgment of a formal duty.

It is superfluous to say that no commentary on modern physics would be read with more widespread interest than that of Sir James Jeans, but it is very pertinent to add that in fulfilling his duty in this respect he is entitled to more sympathy than he is likely to receive. In late years he has given ample expression to his ideas, and his writings have probably been read by all whom he might have expected to hear or read his address. No fundamental theoretical advances have recently been made, and he has therefore been given the problem of presenting the old truths in a new light. He has done this excellently. The substance of the address, in fact, attracts us less than the workings of the mind which made it, and if, as its author says, the present situation "seems likely to lead to radical changes in our views not only of the universe but also even more of ourselves", it is only fitting that we should welcome the opportunity of watching the ideas of one of the acutest minds in England in process of transition.

There are few minds more instructive to watch and none less wearying, for activity is its very essence. The yearning for new fields to explore which led Sir James, immediately after his triumphs with the old mechanics, to turn unregretfully to the new, shows no sign of abatement, and he is as ready to return to a discarded belief, if it shows new possibilities, as he was earlier to abandon it. This mental agility—or restlessness, to use a more

exact word—is so characteristic that it is not inapt to speak of his mind as "for ever voyaging through strange seas of Thought, alone". The comparison with Newton thus suggested is, of course, extravagant, as Sir James himself would insist, but it is convenient because the contrast it evokes is so revealing. Newton, in all his voyagings, saw the boundary of the ocean as an immeasurably distant horizon: Sir James sees it as a bank of fog an arm's-length ahead. To adapt his own favourite metaphor, the river on which he floats perpetually winds, and he cannot imagine what is beyond the next turn. But it would be misleading to direct attention to this intellectual myopia without at the same time pointing out a still more striking quality—namely, the extreme clearness with which he sees the details of his immediate neighbourhood. In Newton's simile, he can only surmise that there is an undiscovered ocean of truth, but there is no better guide to the pebbles on the shore. It is this quality, coupled with the ability to translate vision into words, that captures the attention even of those with whom he is least *en rapport.*

It is important to say this, for otherwise the reader of the new address who has already read "The Mysterious Universe" may think that the change which he observes is a development of physical theory. He would be wrong: it is a development of Sir James's understanding of physical theory. On the question of determinacy, for example, the uncertainty of the former work, with its leaning to the negative side, has now become "complete determinism". It is true that this determinism is said to be different from the old, but, strictly, multiplicity of determinisms is meaningless. Events are either determined or they are not, and in adopting a determinism "which caters for those who ask the question 'What is going to happen next?'", Sir James becomes definitely a determinist. The physics leading to the conclusion, however, has not changed.

Even more significant is the clarification of his ideas on the distinction between subject and object. In "The Mysterious Universe" this fundamental problem was discussed with no sign of a solution. Were electron waves subjective or objective? Were the waves of one electron in the same category as those of two electrons? Was an electron a particle or a wave and, whichever it was, was it independent of our minds? The darkness which called forth these unanswered questions is now broken by a beam of light—faint, indeed, at times, but indubitably light—which again no fresh physical progress has radiated. The task of physics, says Sir James, is that "of reducing to law and order the impressions that the universe makes on our senses", so that the objective element is our sensations and the subjective all that we contribute in the process of creating law and order. Even the inconspicuous intrusion of an undefined "universe" into this phrase is made innocuous by the pregnant remark that "the Nature we study does not consist so much of something we perceive as of our perceptions". Remove from this dictum the unfortunate vagueness contained in the "so much as", and it could not be improved. Objective Nature is our perceptions; theoretical physics with its matter, atoms, electrons, photons, waves, particles, ethers, equations, and what not, is subjective. The distinction between subject and object, a *sine qua non* of thinking, is restored, clear-cut and absolute. The expression of this achievement is admirable.

Admirable, too, is the likening of the atomism of physics to that of a sum of money: a better way of answering the question, Is the atomic theory true? is scarcely possible. The theory is true in the sense that a sum of money cannot be changed by less than the smallest coin, but if one expects the purchasing power of a shilling to be represented by a combination of the purchasing powers of 48 farthings, and offers, say, a farthing for p. 45 of "Macbeth", he will find that his notion signifies nothing. We need no longer discuss the objectivity of the electron.

Yet, in spite of this great development, Sir James's ideas are still in a state of transition. It is abundantly clear that remnants of the old uncertainty co-exist with the new conviction. Hence arise constantly in the address those infallible witnesses to uncompleted meditation for which contradictions is too strong a term and ambiguities too weak. This state of mind is seen in the removal of matter from objective Nature because it is unobservable, and the immediate introduction of a "mysterious world outside ourselves to which our minds can never penetrate", which obviously bears the same disqualification. It is seen in the appearance, within the compass of a hundred words, of the statements that matter is a pure hypothesis, and that we were wrong to confine it to space and time because it might also exist outside—as though a hypothetical entity could have objective properties. It is seen in the

assertion that the electron exists only in our minds but we do not know what put it there, when it has already been made obvious that the need to reduce our sensations (that is, Nature) to law and order put it there. It is seen in the inconsistent remarks (again almost adjacent to one another) first, that in the new physics the mind is an "actor", and next, that it enters physics "only in its capacity as a receptacle".

The same inhomogeneity of thought appears when the possibility of making pictorial representations of Nature, which is removed in the body of the address (we "can never get beyond x, y and z"), is restored in the title. It appears also in the bewildering change of metaphor by which the modern physicist who, in contrast to the old, is represented as building "only on the solid rock, and with the solid bricks, of ascertained fact", is shortly afterwards said to be "concerned with appearances rather than reality". It appears again in the statement, reminiscent of "The Mysterious Universe" period, that "Heisenberg's mathematical equation shows that the energy of a beam of light must always be an integral number of quanta" instead of "the observation that the energy of a beam of light is always an integral number of quanta leads to Heisenberg's mathematical equation". It appears once more—but why continue piecemeal? It appears, in brief, throughout the address.

Now unless one discerns the source of this welter of paradox one might easily dismiss the whole address as the product of an irresponsible trifler. No profounder mistake could be made. The confusion all proceeds from the fact that the new wine of Sir James's thought is not yet separated from the old bottles. He has seen light, but has not yet adjusted his eyes to a clear view of what it illuminates. Only one thing is needful to convert the apparently muddy swamp into an obviously crystal lake; namely, the realisation that the truth at which he has arrived is an analysis of mind and not, as he tries to make it, an analysis of matter. Sensations on one hand and, on the other, rational thought "reducing to law and order" those sensations, are the products of a mental analysis, sensations being the object not of a vague undifferentiated "mind" but of that element of mind which reasons and produces theoretical physics.

This is the essence of Sir James's philosophy, and he has not realised it. 'Mind' throughout the address is used indiscriminately for that which perceives and that which conceives. The external world, he says, "is essentially of the same nature as mental ideas"; and, the external world having already been identified as our perceptions, it follows that perceptions are of the same nature as ideas—which he does not at all mean. By the same oversight he speaks of "knowledge" without distinguishing the reception of sensations from the dawn of ideas. "Nature," he says, "consists of waves . . . of the general quality of waves of knowledge." But again, Nature being our perceptions, it would follow that whether or not I see Sirius when I look in a certain direction depends somehow on my knowledge of its co-ordinates. Sir James does not mean this. He is really thinking of electrons, not "Nature": it is only our ideas, not our perceptions, that can be represented by "waves of knowledge".

This distinction is particularly significant in relation to the "two determinisms", which can scarcely fail to puzzle many readers. "Things still change solely as they are compelled," says Sir James, "but it no longer seems impossible that part of the compulsion may originate in our own minds." Now everything here depends on what is meant by "things". The uninitiated reader naturally identifies "things" with physical events; but everyone knows that even if psychology allows us by taking thought to add to our own stature, we cannot thus add to the stature of Snowdon, nor does that stature change when we discover what it is. The content of our perceiving mind (that is, Nature) is given us independently of our will and our knowledge—except, of course, for such trivialities as that if I want to see a penny I can produce one and look at it. It is the creations of our *conceiving* mind that do not act independently of our knowledge of them, and from the proper view-point this appears entirely natural, if not obvious. "Nature no longer forms a closed system detached from the perceiving mind". True, because Nature is the content of the perceiving mind; but it is still a closed system detached from our cogitations about it.

When Sir James has fully understood the implications of his beliefs—as so logical a thinker must inevitably do—one of the most salutary effects will be the cessation of the somewhat disparaging remarks concerning the 'old' science which he still makes. For indeed, what the 'new' science preaches is precisely what the 'old' science practised. Matter is a hypothesis and nature is our sensations, says Sir James, and no better illustration of this

truth could be found than the science of the last 250 years. A billiards-ball and a piece of sugar, for example, are material objects, but did the 'old' science respect their individuality? Did it construct laws of billiards-balls and laws of sugar? Not at all. It ruthlessly broke up the association of white colour, cubical shape, hard feeling, immobility and the rest which make up the sugar, and, coupling the whiteness with the redness of the billiards-ball, made laws of optics; out of the immobility of the sugar and the rolling of the ball it extracted laws of motion; and so on. The naïve world of myriads of objects, each comprising a few sensations, was disintegrated, and the sensations were re-partitioned into a few groups each containing myriads of them.

There is no distinction between old and new science, except that the new has comprehended the old. It may be true to say that the older physicists did not know what they were talking about, but we must not omit to add that nevertheless they were talking sound good sense. We have not superseded their methods; we have simply understood them. Science has not apostatised; it has become self-conscious. For this reason we feel that when Sir James represents the former theoretical physics as a building in ruins, his customary aptness in illustration has deserted him. Much better is his later analogy of the cartographer. The last generation gave us a map of Surrey. We have now produced a map of Europe, but that of Surrey has not thereupon magically fallen to pieces: it still guides us unerringly to Dorking. Nor does anyone know better than Sir James that Newtonian mechanics, so far from being in ruins, is more firmly established than ever as the form taken in ordinary circumstances by the mechanics of relativity.

If, however, the address, as an *ex cathedrâ* statement, leaves something to be desired, there is, we repeat, abundant recompense in its promise of better things to come. If we are inclined to regret that the presidency of our greatest public scientific institution did not wait to adorn a maturer stage of Sir James's intellectual evolution, we draw comfort from the knowledge that other means of expression exist. Those who, oblivious to other considerations, can enjoy felicity of phrasing and ingenuity of illustration, will hear his latest utterance with undiminished pleasure; but when he attains to full consciousness of his own convictions, and to distinctness of vision adds depth of insight, the world will listen. H. D.

Principles of Regulation in the Organism

Features in the Architecture of Physiological Function. By Dr. Joseph Barcroft. (Cambridge Comparative Physiology.) Pp. x+368. (Cambridge: At the University Press, 1934.) 20*s.* net.

TO an outside observer who has had to use and study French, German and English textbooks and comprehensive treatises in the biological sciences, a very definite difference is apparent between the best specimens in each of the three languages, illustrating, I believe, the fundamental characteristics in science of three great nations. The typical French textbook is the 'traité pratique', describing with admirable precision instruments and methods by which results are obtained. The typical German book is the ponderous 'Handbuch' into which facts and results are crowded and systematically arranged. The typically English contribution is the 'Principles', written from a definite point of view and dealing with fundamental mechanisms.

Although the word itself does not appear in the title, the book here under review is a fine specimen of English 'Principles' and might have been designated "Principles of Regulation in the Animal Organism". The main thesis is developed in the three first chapters of the book, devoted to the discussion of Claude Bernard's famous dictum: "La fixité du milieu interieur est le condition de la vie libre". It is shown in these chapters that constancy of the internal environment is the result of an evolutionary process, that most animal functions are independent of such constancy, that a number of mechanisms exist by which lower animals are able to carry on and lead a fairly 'free' life in spite of large variations in the internal as well as the external environment, but that the higher nervous functions, developed especially in mammals (and birds), and constituting the essential basis for the existence of civilised man, do require the constancy within very narrow limits of the 'milieu interieur' as expressed by its chemical composition and temperature. The effects of variations outside these limits in temperature, hydrogen ion concentration and oxygen pressure, are known to Barcroft from personal experience. His discussion of them is most illuminating and should be carefully considered in any experimental study of the bodily functions in man.

Subsequent chapters deal with the mechanisms essential for maintaining the constancy of internal environment and cover a very wide field. It is pointed out that with an intermittent supply a constant internal environment can be maintained only by means of effective storage mechanisms,

and these are discussed in three chapters with a wealth of important detail. The succeeding chapters on the integration of adaptation appear to the reviewer as especially significant. Activity of whatever kind demands or produces certain changes in the internal environment, and Barcroft shows how these changes involve always a number of separate factors in such a way that the change in each can be kept within those limits which are essential to the 'free life' of the organism as a whole. The discussion of the mechanisms of oxygen supply to the growing fœtus, involving shifts in opposite directions of the O_2-dissociation curves of the maternal and fœtal hæmoglobins, is especially fascinating and, of course, the adaptations to meet conditions of 'anoxia', a favourite object in Barcroft's own experimental work, are dealt with in a manner that leaves nothing to be desired. 'Anoxia', by the way, is a new and useful term, designating "any condition which retards the oxidation processes in the tissues".

One chapter (x) is devoted to a discussion of the 'all-or-none' relation. The connexion of this with the main theme of the book is not very apparent, although in a 'Handbuch' it would have to have a chapter, and my impression is that it is not yet ripe for really fruitful discussion. It may be something basal, but Barcroft believes it to be a specialised form of reaction.

The last chapter (xv) on "The Chance that a Phenomenon has a Significance" presents to my mind a peculiar charm. It points out several examples of 'accidents', like the yellow colour of the yolk in eggs, turning out to have a deep significance, and I emphatically subscribe to the last paragraph: "Accidents happen in Nature as elsewhere, but having regard to the above and other considerations, I range myself on the side of those who regard a phenomenon as more likely to have a significance than not. Those who think with me must shoulder the burden of discovering what the significance may be, but on our opponents rests the much heavier burden of proving the phenomenon to be an accident, if indeed it be such."

It is inevitable, when so many facts are marshalled, that there should be differences of opinion as to their significance. I do not find more than one or two points on which definitely to disagree with Barcroft, and a few more on which I should put the emphasis differently. Two examples will suffice. When the striking psychical effects of breathing air with 7·2 per cent carbon dioxide are ascribed to the resulting increase in hydrogen ion concentration, I would point to the fact, recently confirmed in Copenhagen, that the *p*H of the blood can be shifted considerably towards the acid side by taking ammonium chloride, without any disagreeable effects, and I would therefore take the carbon dioxide as such to be responsible.

In Chap. xii on "The Principle of Antagonism", where autonomic innervation is discussed, I believe that the modern views on neurohormones could with advantage have been taken as the starting point.

Barcroft's book is not very easy reading, but requires and repays careful study. A large number of experimental researches from many sources, including, of course, those originating in Barcroft's own laboratory, are discussed and made to form coherent pictures of absorbing interest in many cases, but the significance of these as illustrations of fundamental principles is largely left to be inferred by the reader. The inferences, it is true, are given briefly at the end of each chapter, but I for one must confess that I have had more than once to look over the field again in order to see the facts in the right perspective. Perhaps that is what Barcroft has meant those of his readers to do who are not bright enough to get the right viewpoint at once, but will they? My experience with the book is that it is certainly worth doing.

AUGUST KROGH.

International Quarantine Regulations

Office International d'Hygiène Publique. Application of the International Sanitary Convention of Paris, 1926. International Quarantine Directory (giving Information on the Equipment and Organisation of the Public Health Services of the Ports of Different Countries). Pp. xxxviii + 1039. (Paris: Office International d'Hygiène Publique; London: Dr. M. T. Morgan, Ministry of Health, 1934.) 21*s*.

A WHITE Paper published a few weeks ago (Cmd. 4650), giving the text of the "International Sanitary Convention for Aerial Navigation" signed at the Hague, marks a notable extension to air traffic of 'quarantine' measures which in one or another form have been imposed for centuries on arrivals from foreign countries by sea and land. Drawn up by the International Office of Public Health in Paris in consultation with representatives of the air services, the Convention provides the adhering countries with a practical code of action, defined in terms of maximum permissive action, which can be applied at aerodromes to foreign aircraft likely to be bringing exotic infections. An obvious example of the risk is the case when an air route enables persons or mosquitoes to be brought within two or three days from the West African countries where yellow fever has long been endemic, to East Africa or regions farther afield, which have never yet known yellow fever, but possess the necessary

insect carriers as well as human populations which are all too liable to develop the disease in epidemic form, if once the infection is introduced.

The transmission of yellow fever receives special attention in the new Convention, but other infections, notified internationally and habitually guarded against at seaports, are taken into account. When, for example, a country abroad is suffering from severe smallpox or cholera, there are precautions which the health authorities at the aerodromes of arrival can and should properly take, and there are other forms of 'preventive' action which they should reject, even in face of temporary public outcry, as being unprofitable as well as vexatious. Good administration requires international understandings on all these matters.

The new sanitary code for air traffic has been made possible only by the previous overhaul of quarantine measures applied to ships which was undertaken when the general International Sanitary Convention was last revised in Paris in 1926. Important new principles were there introduced. Information about the prevalence of the chief diseases concerned is now exchanged, rapidly and regularly, between the health departments of different countries through the International Health Office in Paris, or its regional bureaux at Singapore, Washington and Alexandria—a system which enables much of the former unwieldy diplomatic procedure to be dispensed with, and saves the ship from many interrogatories and the production of health documents which were generally as useless in practice as they were venerable in origin.

Given the present system of international intelligence, ships are now dealt with according to the particular epidemic risk involved, while in place of measures applied indiscriminately to countries or vessels considered 'infected', the Convention has laid down agreed lines and limits of action dependent on the nature of the voyage and appropriate to the natural history of each infection. Plague now has its special quarantine measures based on rat proofing and rat destruction; typhus on disinsectisation; for cholera and smallpox there is a range of measures between the simplest form of medical inquiry and inspection and the 'observation' and bacteriological examination of persons likely to be incubating the disease, and so forth.

There can be no question of the benefits which the rationalisation thus effected in 1926 has brought to public health, shipping and to the convenience of the travelling public. But it is not to be supposed that all the ports in the world —even the largest—apply the international rules in the same way. There are endless differences in practice, some inherent in the physical configuration or arrangement of the port, some dependent on political engagements and peculiarities of its administration, and many which result from the nature of its principal commerce, its wireless communications, and its general equipment. The International Health Office has consequently done a very useful service by obtaining from one hundred countries and dependencies, covering practically every seaport of importance in the world, a summary describing, *inter alia*, its port sanitary services in general, the methods ordinarily adopted at each port on the arrival of ships, the ports which undertake systematic destruction of rats and the issue of certificates of rat-inspection, the ports which are open to infected ships, and the special agreements which have been made with other countries to facilitate quarantine operations.

The information, well put together under the title of the "International Quarantine Directory", makes a considerable volume designed primarily for the use of port health officers, shipping companies and ships' doctors. The labour involved in its preparation and its translation into English from the equivalent "Répertoire Sanitaire Maritime International", should, however, be repaid later in a wider sense. The different regulations and practices carried out under the name of quarantine and in the interests of the public health can now for the first time be examined as a whole. Their confrontation shows how often, notwithstanding the progress marked by the international agreement of 1926, there is still room for improved and simplified methods based not only on modern knowledge of the nature and transmissibility of infections, but also on the further development of the mutual confidence between the public health administrations of the world which this admirable little technical office in Paris has done so much to bring about in recent years.

The Extent and Causes of Poverty

The Social Survey of Merseyside. Edited by D. Caradog Jones. Vol. 1. Pp. xxii+328. 15*s.* net. Vol. 2. Pp. xvi+413. 21*s.* net. Vol. 3. Pp. xviii+560. 25*s.* net. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1934.) 3 vols., 45*s.* net.

MR. CHARLES BOOTH'S great work "Life and Labour of the People", which described conditions in London forty years ago, and introduced the method of measuring the extent of poverty with reference to a defined 'poverty line', has had as its sequel similar studies in a number of towns, including the "New Survey of London Life and Labour", now approaching its completion. The School of Social Sciences and

Administration of the University of Liverpool, under the editorship of Mr. Caradog Jones, has now issued the results of four years' investigation on the social and economic condition of the working classes of Liverpool, Birkenhead and neighbouring smaller towns, assembled under the convenient name of Merseyside.

Though this inquiry includes a much fuller account of local public administration than do the others named, it is mainly on the same lines as the London studies, and since the same definitions of poverty, overcrowding, etc., are used as in London, and as in a recent work by Mr. P. Ford on Southampton, exact comparisons can now be made between the conditions in a number of great towns. It would be tempting to generalise to the whole urban population of England, if it were not for the fact that the proportions suffering from poverty in its various forms vary so greatly from place to place, that no general averages can safely be established. But while the percentages vary, the main causes of poverty and its visible effects are similar in all the towns in which investigations have been made, and some qualitative statements can be made which are probably true for industrial England as a whole. Here, however, we shall deal only with Liverpool, making some comparisons with London.

There is scarcely any question of current economic interest on which these volumes do not throw light. The chapters relating to housing problems, the extent and nature of overcrowding, and the number of, and provision for, subnormal and incapacitated people, are full of interesting detail: and there are many other sections of importance to those who have a practical interest in administrative and social problems.

The most generally interesting section is that relating to the extent and causes of poverty. Poverty is defined, as in all the recent studies of this kind, in relation to an intelligible but conventional minimum standard, computed with reference to the number, sex and age of persons family by family: the standard for food is barely up to that considered necessary especially for young children, though it is not a bare minimum since it takes as its basis the kinds of food which are usually purchased. The allowance for clothing, fuel and other necessaries is very low, and there is no margin for luxuries or for emergencies. For comparison between the towns to which it has been applied, it affords an adequate measurement. In Merseyside in the year 1929 or 1930 more than seventeen per cent of the working-class families failed to reach this standard, judging by their apparent income in the week of investigation, as compared with ten per cent in London at the same date. In 1932–33 the proportion must have been somewhat larger. In income is included receipts from pensions and from the unemployment organisation. It is nearly indifferent whether public relief or charity is counted as income or not, since these sums are rarely sufficient to raise a family above the poverty line.

The proximate causes of poverty can be classed under three main headings: non-existence of an adult male in full work, insufficient employment, and insufficient wages at full work. To the first of these was due the poverty of 5·4 per cent of working-class families in Merseyside, 5·2 per cent in London; to the second 10·9 per cent in Merseyside, 3·5 per cent in London; to the third 0·9 per cent and 1·1 per cent respectively. Lowness of wage-rates is no longer a major cause of poverty; it is replaced by unemployment. It must be remembered that these percentages apply to the working-class population, and they would be reduced if the whole population was brought into the account, in the proportion of about 6 to 5 in London, and probably to a similar extent in Liverpool. On the other hand, while a great number of incompetent persons are included in these figures of poverty, there is also an institutional population to be supported by public or private funds.

A considerable part of vol. 3 is devoted to the study of defective persons, to the consideration of how far they contribute to the poverty total, and in particular what is the extent of the group whose offspring are likely to swell the numbers of the incompetent, the poor and the deseased—characteristics which are certainly to some extent associated. A student of inheritance will find a good deal of material for consideration; but it is not arranged so as to be easy to use, and there are insufficient controls to bring the particular cases of inheritance, for example, of blindness, into relation with a normal population.

The final chapter, on differential fertility, establishes again the often stated fact that the economically undesirable classes are on the whole more prolific than the rest of the people, but it is doubtful whether the figures, even if retabulated so as to bring the problem into the right focus, could serve to measure the present or future effect of this differentiation.

Though all possible use is made of the census and other general sources, the more novel results are obtained by the same method of sampling as has been used in the London inquiry. This investigation appears to have been carried out very conscientiously and successfully, and, though the mathematical basis of the method is not discussed at any length, care has evidently been taken only to use results which may be expected to have sufficient precision.

Short Reviews

Adult Education in Practice. Edited by Robert Peers. Pp. xiv+301. (London: Macmillan and Co., Ltd., 1934.) 7*s*. 6*d*. net.

THIS book is a rather idealistic survey of the progress and practice of adult education in Great Britain. It is written by a number of heads of university extra-mural departments, all of whom have played a leading part in the national development of the movement and possess first-hand knowledge of its several aspects. As a description of the ideals, nature and activities of the movement, of the types of students involved, of the methods of teaching and of the qualities desirable or necessary in extra-mural teachers, the book is extremely interesting. It can be read with value not only by lecturers and tutors taking an active share in adult teaching but also by many academic professors, who often have little idea and less experience of adult education, and who sometimes show what can only be regarded as intolerance and a certain intellectual snobbery concerning it. Much academic teaching would be vastly improved if some of the pedagogic methods and ideals herein discussed were more widely realised.

Ideals and enthusiasm, however, are not enough, and the book would have been more valuable had it been more critical. The adult education movement has had a long and chequered career, and much progress has been made, especially since the War. The facts, however, that this progress has not been even more rapid and extensive and that many fields of knowledge, especially science, are still almost absent from the purview of the movement, suggest the existence of fundamental lacks and defects which need to be recognised and dealt with.

The last third of the book consists of various appendixes which bring together in convenient form various official regulations and prospectuses and useful lists of addresses and references concerning adult education. W. B. B.

A Textbook of General Botany: for Colleges and Universities. By Prof. Richard M. Holman and Prof. Wilfred W. Robbins. Third edition. Pp. xv+626. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 25*s*. net.

AN appendix of books for collateral reading makes this a good textbook for students reading for a general degree in the subject. The book itself is well written, with a good choice of subject matter. It is profusely illustrated, with splendid diagrams and photographs. Though written by American teachers for American students, the material for study is very general, and the types are those usually accepted for all students. A list of reference books is, of course, essential to students, but that given in this volume has a distinctly American character, which is a pity, since the book itself might be thoroughly recommended to British students, too. For a book of more than six hundred pages, with a wealth of illustrations, the price is reasonable.

Elementary Engineering Thermodynamics. By Prof. Theodore H. Taft. Pp. v+229. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 16*s*. 6*d*. net.

THIS book deals briefly with the fundamental principles of thermodynamics and their applications to some of the more common problems in mechanical engineering. The subject matter includes work on the general properties of gases and vapours; the flow of fluids through nozzles; elementary consideration of the steam turbine and reciprocating engine; refrigeration; fuels and combustion.

Although the author has presented nothing that is new, he has certainly made clear many points not easily understood by the student beginning this subject. The diagrams provided contribute largely to the utility of the work, and several problems have been fully worked out as illustrations of some of the more important and often less-understood principles. The book can be recommended to students reading for degrees and wishing to supplement their lecture course.

Traffic and Trunking Principles in Automatic Telephony. By G. S. Berkeley. Pp. xi+241. (London: Ernest Benn, Ltd., 1934.) 10*s*. 6*d*. net.

THE object of this book is to bridge the gap between theory and practice. To students and engineers of telephony it can be commended. The growth of automatic telephony has been marvellously rapid, and few outside the Post Office are aware of the numerous problems that had to be satisfactorily solved before progress could be made. Questions are often set on this subject in technical examination papers, and examples with answers are given at the end of the chapters. 'Trunking' in telephony means that branch of the subject that is concerned with the provision and arrangement of the plant required to carry the traffic with a specified grade of service. In the second edition, it would be useful if the author utilised some of the theorems given in the theory of statistics to 'holding time', 'traffic flow' and 'busy hour' problems.

Logic in Practice. By Prof. L. Susan Stebbing. (Methuen's Monographs on Philosophy and Psychology.) Pp. ix+113. (London: Methuen and Co., Ltd., 1934.) 2*s*. 6*d*. net.

THIS very able little book goes a long way to prove that logic is a human science, and not merely a more or less coherent collection of dry and irrelevant dogmas. The grounds of our beliefs, the purpose of thinking, the importance of form, and the fundamental principles of deduction and induction are analysed and explained in a way that should make their understanding easy and interesting. What adds to the value of Dr. Stebbing's book is the choice of the examples, which should make nonsense of the frequent reproach that formal logic is an idle game.

T. G.

The New Elementary Particles

By PROF. E. N. DA C. ANDRADE

ABOUT three years ago, the first period of investigation of the structure of the atomic nucleus may be considered to have closed. This period, of which the achievements include the artificial disintegration of the nuclei by alpha particles, the investigation of the energies of the protons ejected from these nuclei and the first investigation of nuclear levels by means of the beta ray spectra, was characterised by the general belief that all nuclei were, in the ultimate, to be considered as being built up of protons and electrons. The only other particle of an elementary kind which was considered as a nuclear constituent was the alpha particle, and this was generally accepted as being itself built up of 4 protons and 2 electrons.

It was stated as axiomatic that the unit of mass was always found in conjunction with the unit positive charge, and that the electron, the unit charge of negative electricity, had no positive counterpart—the unit positive charge could not exist apart from matter, in the ordinary sense, or the unit of matter apart from positive charge. Not only have both these beliefs proved to be untenable, with the result that, as will be discussed later, the electron is no longer considered to be one of the ultimate constituents of the nucleus, but also a particle of mass 2 and charge 1, which is, then, an isotope of hydrogen, of double the mass of the ordinary hydrogen atom, has been discovered. The new particles—the neutron, the positive electron or positron, and the isotope of hydrogen—have recently been the subject of a number of important researches, and their discovery has, as is usually the case, solved certain problems, and raised a host of new ones in their place.

The discovery of the neutron was the result of work in Germany, France and England, but the critical experiments found Cambridge ready to recognise their implication, since, many years ago, Lord Rutherford had contemplated the possible existence of such a particle, that is, a particle having mass, but no charge, in contradistinction to the electron which has charge but no material mass. He had even looked for it, but without success. The first step towards the new discovery was furnished by the experiments of Bothe and H. Becker, who in 1930 were working on the effect of bombarding various elements with the alpha rays from polonium, which have the advantage of being free from the accompaniment of beta and gamma rays. They were looking for long-range protons on the lines of the experiments of Rutherford, Chadwick, Pose and others. They found that certain light elements, notably lithium, boron and fluorine, gave rays which passed through 2 mm. of brass, while beryllium was particularly productive of such rays. The rays were more penetrating than was to be anticipated of any known corpuscular radiation, and the experimenters assumed without question that they were gamma rays.

The work was continued by Joliot and Irène Curie-Joliot, who used a much stronger source of polonium and showed that the radiation excited in the beryllium nucleus could penetrate several centimetres of lead: since then, it has been detected through 30 cm. of this metal. The French workers found that the beryllium radiation could expel protons from paraffin wax, protons which they detected in a Wilson cloud chamber. The range of these protons was, however, such as to offer great difficulties on the supposition that the radiation was of a wave nature, impelling the protons by the Compton effect. It was left for Chadwick, who, within a day or two of the French publication, was experimenting on the subject, to point out that all the difficulties could be met if the radiation was of a particle nature.

Both a wave-packet and a particle can transfer energy and momentum to a second particle. In both cases a particle of a certain energy, $h\nu$ for a wave-packet, and approximately $\frac{1}{2}mv^2$ for a particle, strikes the proton, say, considered to be at rest: the result of the collision is that the proton moves off in a certain direction with a part of the energy, while the impinging unit moves off in another direction with the remainder. In the case of an impinging particle, however, the momentum is obtained from the energy by multiplying by 2 and dividing by the velocity of the particle in question (supposing that relativity considerations can be neglected), while in the case of the wave-packet we divide by c. Since we have to consider both energy and momentum equations, the laws of collision are clearly different in the two cases, one where we deal with particles only, and the other where we deal with wave-packets and a particle. Suffice to say that the observed range of the struck proton can be easily reconciled with the particle law, but not with the Compton, or wave-packet, law. The deciding factor is not a qualitative observation, which furnishes no criterion, but a quantitative measurement.

The particle concerned clearly cannot have any charge, or its interaction with matter would stop it within a small fraction, of the order of a hundredth, of the distance which it actually traverses in a metal. Since Chadwick's announcement early in 1932, neutrons have been produced from

other light elements, for example, boron, and by other means than the impact of alpha particles, notably that of protons accelerated in an electric field. The equations for the transfer of momentum which established the particle nature of the neutron, also showed that its mass is approximately that of the proton. The exact mass of the neutron can be obtained by considering the masses of the particles concerned in its production ; for example, in the case of an alpha particle striking the nucleus of the 11 isotope of boron

$$ {}_5B^{11} + {}_2He^4 = {}_7N^{14} + n, $$

the neutron being denoted by n. The masses being accurately known from Aston's measurements, and allowance being made for the mass equivalent of the kinetic energy, a value of 1·0066 was obtained by Chadwick, which has been confirmed by the consideration of collisions with other atoms*. Other methods give slightly different results, however, and while it can be stated that the mass of the neutron lies very close to that of the proton, there is some doubt as to whether it is slightly greater, slightly less, or equal to that mass.

The history of the positive electron starts with the experiments of C. D. Anderson, of Pasadena, who was using a Wilson chamber, operating in a magnetic field of some 15,000 gauss, to detect particles released by cosmic rays. The curvature of the tracks of the particles gives their energies, but the sign of the charge cannot be decided unless we know the direction in which the particle is travelling. Anderson found not only that a particle, which from the appearance of the track (density of ions) was an electron, could pass through a plate of lead 6 mm. in thickness placed across the chamber, but also that the curvature was markedly different on the two sides of the plate. Supposing, as is only natural, that the greater curvature is on the emergent side of the plate, we can at once deduce the direction of travel, which, in the case of one of Anderson's early photographs, implies a positive charge on the particle. The mass of the particle can be deduced from the fact that the velocity of a particle making a track of given curvature in a given field depends upon its mass, while the ionisation depends upon the velocity and the charge, but not on the mass. Ordinarily, the ionisation produced by a proton of given curvature of path will be much greater than that produced by an electron of the same curvature in the same field. Anderson concluded that he had a record of a particle of positive charge and of mass much less than that of a proton.

About the same time, Blackett and Occhialini were experimenting on the same lines with a chamber in a magnetic field, with the great advantage that, with the help of a coincidence method employing Geiger-Müller counters, they had devised an automatic release, the effect of which was that the expansion only took place on the passage of a cosmic particle, when they had something to record. They obtained records of groups of particles, often round about twenty in number, the tracks of which all radiated from a point. This furnishes a new type of evidence of direction of travel, since it is very difficult to imagine any mechanism which can lead to many independent particles all rushing to the same point. The groups, or 'showers' as the experimenters called them, are evidently produced by one cosmic ray particle of high energy interacting with an atom of matter in the neighbourhood of the chamber. By a consideration of the tracks in showers and of tracks passing through a plate of metal, of the ionisation, the field and the curvature of the tracks, Blackett and Occhialini were led to the conclusion that the particles had a positive charge of magnitude equal to that of the electron charge and had the mass of the electron. To such particles, the name positive electron or positron has been given. The same conclusion has been furnished by further experiments of Anderson. It is noteworthy that Dirac's theory had already, in a sense, predicted the existence of such particles, and also given a reason why they should only be observed under exceptional conditions, since their free life must be very short.

The discovery of the isotope of hydrogen, of mass 2, has been so recently discussed in NATURE (March 31, p. 481) that there is no need to trace its history. Let us call the nucleus of mass 2 and charge 1 a diplon, and write it ${}_1H^2$, while a hydrogen gas made up of molecules of this kind, ${}_1H^2{}_2$, we will call diplogen. The use of the new atoms as projectiles has led to very interesting results in the field of artificial disintegration. In the experiments of Lawrence, Lewis and Livingstone, of Rutherford and Oliphant, and of Cockcroft and Walton, bare diplons produced in a discharge tube are accelerated in a field of some hundreds of thousands of volts, and the stream is directed on to light elements. Nuclear reactions of the type

$$ {}_5B^{10} + {}_1H^2 = 3\,{}_2He^4 $$

have been produced, to be added to what is fast becoming a special chemistry of the nucleus. Oliphant, Harteck and Rutherford have been led by this type of experiment to the belief that the helium isotope ${}_2He^3$ can exist.

According to G. N. Lewis and his collaborators at Berkeley, a diplon has been recently disintegrated into two protons by proton bombardment, the energy of the impinging particles corresponding to 1·5 or 3 × 10^6 volts, so that in any case there is no need to consider it as a fundamental constituent of atomic nuclei. Lawrence

* See also NATURE, August 18, p. 237. Ed.

and his collaborators, and Cockcroft and Walton, have likewise found that the diplon is unstable in a strong nuclear field. As for the alpha particle, while it is convenient, especially for radio-active considerations, to regard it as a separate entity, there is little doubt that it is a particularly stable structure built of the fundamental entities of nuclear structure.

We are left then with the neutron and the positron as fundamental new particles to be added to the proton and the negative electron. Clearly, on paper, two or more kinds of these particles can be used to build up nuclei of any given mass and charge. Before the new discoveries, the proton and the electron were taken as basic particles: there is now a measure of agreement that the proton and the neutron are to be taken as the fundamental constituents of all nuclei, the electron as such having no existence in the nucleus.

The reasons that have led to this conclusion can only be very briefly indicated. One is that difficulties concerning the measured spin of certain nuclei, which arise if the electron be considered as a nuclear component, can be explained on the proton-neutron basis. Again, the number of particles in the nucleus gives a wrong type of statistics for the nuclear particles, as evidenced by the alternating intensities in band spectra, if the electron is admitted as a nuclear particle. For nitrogen, for example, the total number of nuclear particles should be even, as it is on the basis of 7 protons + 7 neutrons, while it is odd on the basis of 14 protons + 7 electrons. Another argument against the nuclear electron is furnished by Dirac's electro-dynamics, which leads to grave difficulties if we try to confine an electron in the limited nuclear space. A rough analogy, which must not be pressed, is offered by the classical treatment of the light quantum, which must travel and cannot be confined to one spot. Fermi suggests that the electron is ejected from the nucleus by a quantum switch somewhat analogous to that which ejects the photon, or light quant, from the atom. When a neutron switches over to a proton a negative electron is liberated; when a proton switches over to a neutron a positive electron is yielded. We can, then, think of neutron and proton as two different internal quantum states of one and the same fundamental particle.

Finally, a word may be said about the hypothetical 'neutrino', a particle which not only has not been detected, but may even be impossible to detect. The trouble is that the experimental facts of the beta ray spectrum are against the conservation of energy and momentum, both linear and angular: on the other hand, the conception of conservation is a valuable and familiar tool, the use of which is involved in all our usual atomic calculations, and the desire to preserve it justifies strange assumptions. Now the conservations can be retained even for the beta ray spectrum if we introduce a new particle with certain *ad hoc* properties. The mass must be much less than that of the electron, probably zero, like that of the light quant. The spin quantum number must be $\frac{1}{2}$, as with the proton and electron. The ionisation produced must be extremely minute, say one ion in a path of 150 km. in air at N.T.P., which is one reason why detection is so unlikely: further, any reaction with nuclei must be extremely small. A particle with these properties and lack of properties has been called a neutrino. An entity which it is practically impossible to detect is not a very attractive hypothesis, but in the present stage of development it is, to say the least, a convenient way of expressing our difficulties about conservation—of packing them all in one bag, as it were. The neutrino may be likened to one of the face-saving formulæ so popular with our statesmen: it may not solve any problem, but with a new word it stops troublesome questions for the time being.

Recent Gliding Performances and their Meteorological Conditions

By SIR GILBERT WALKER, C.S.I., F.R.S.

THE impelling force in the life of one at least of the ablest designers of sailplanes and aeroplanes is the desire to quicken and cheapen transport, with the object of facilitating acquaintance with other countries and promoting international good feeling. Whether the need of national defence is admitted or not, airmindedness is warmly to be welcomed, and far more people can cultivate it by sailplanes than by power-driven machines. But in Great Britain, habits change slowly, and comparatively few have realised the chances offered by gliding of indulging their love of adventure, or of developing the team spirit.

Even in Germany, where the movement secured a firm hold owing to treaty restrictions on power-flight, the removal of the restrictions ten years ago led to a critical period when the survival of gliding was in doubt: the situation was then saved by the formation of the Rhön-Rossitten Association, with a material subsidy from Government, a central institution for research, and the consequent growth of technical ability. In England, growth has naturally been dependent on local enthusiasm: of the clubs that were started, many lasted long enough to train their members to glide downhill for short periods: but it is

soaring that is the soul of the movement, and the transition to this has in many cases involved great difficulties. Soaring requires machines that are more costly to buy and to maintain, suitable sites and increased facilities for repairs and for teaching. When, however, the onward march has begun, every step forward makes progress easier. At the first gliding competition at the Wasserkuppe in 1920, the record flight was only of 2 min. 22 sec. duration and 1,830 metres length; in 1922, the distance record was 6 miles; in 1925, 12 miles; and in 1930, 60 miles. Since then the use of the ascending columns under cumulus clouds, of the upwinds in front of line-squalls, and of local convection currents, has greatly extended cross-country flights; and the record at this year's competition was 235 miles.

Recent British performances have shown skill comparable with these: and in several long flights the limit has only been imposed by the dimensions of our island, the flights appearing capable of indefinite extension, but for the need of alighting on reaching the coast. Thus in 1933, near Marlborough, Mr. G. E. Collins climbed in a two-seater to 2,150 ft. with very little wind and no clouds, by the use of thermal currents. In March this year, Mr. P. A. Wills reached 4,600 ft. in a journey of 55 miles, and Mr. Collins covered 45 miles with a passenger. But the climax came on August 5 last, when Mr. Wills climbed from Sutton Bank, near Thirsk, to 6,000 ft. above sea-level; and Mr. Collins flew 98½ miles from Dunstable to the coast near Hunstanton. Both Mr. Collins and Mr. Wills have been awarded the 'Silver C', the most advanced certificate attainable, of which there are only about thirty holders in the world.

These performances are of the happiest significance as evidence that gliding has taken root in England; and they raise questions of considerable physical interest regarding the extent and origin of the up-currents that make them possible. Both pilots have been good enough to provide me with notes on their flights, and on these the following accounts of the conditions are based.

At Sutton Bank, there is a steep semicircular amphitheatre or bowl facing west, where the ground rises from 350 ft. above sea-level to 950 ft. There was on August 5 a light south-south-west wind of 5–10 m.p.h. with fairly developed cumuli at about 4,500 ft. On the upward wind-component made by the impact of the air on the slope, the ordinary 'hill-lift' would have raised the sailplane to 100 ft. or so above the crest. Mr. Wills "kept on getting thermal lift [that is, on convection currents] and circling up to about 3,000 ft., starting over the valley and finishing about a half-mile 'inland', when the lift would fade out. . . . There was blue sky over and round the bowl, cumuli everywhere else." In the meantime, Mr. Dewsbery had started near the north end of the bowl and struck a 'thermal' quite low down; at a time when Mr. Wills lost his lift and began to descend very fast, 10 ft. a second sometimes, his companion went on climbing, shot vertically past him half a mile away and finally went off across country; he could find lift in any direction and finally landed near Bridlington, about 55 miles away. About one and a half hours after this loss of height, Mr. Wills struck an up-current about a mile 'inland' which took him right up to a cumulus, whereupon he hastily left it. The rate of climb averaged 4–6 ft./sec. below the cloud and in it "he could not evade about 12–14 ft./sec."; to get the upward velocity of the air there must be added to these figures the sinking speed of the sailplane, or 3 ft./sec.

The pilot's anxiety to keep out of the cloud was not unnatural. Thus on July 15, in order to get out of a cloud, Mr. Wills had pushed the stick hard forward, so as to dive rapidly. The speed went up to 50 m.p.h., but the rate of *climb* was still 5 ft./sec. The stick was pushed yet farther forward, the speed rose to 70 m.p.h., and still rising slowly he shot out of the side of the cloud; on this the machine started descending at a rate beyond the range of the indicator! This contrast of the vertical currents on the margin of a cumulus cloud is well known to advanced pilots.

Let us consider how far these experiences agree with ordinary meteorological ideas. It is known that, apart from heat effects, a very light wind blowing across a ridge with gently sloping sides will flow without turbulence and with stream-lines tending to be parallel to the slopes. If the wind is strong, or the slopes steep, an eddy will form on the lee-side which produces a down current dangerous to aviators. The lift produced by the upward component on the windward side will raise a glider above the crest to a height (the hill-lift) dependent on the conditions, but something like a quarter of that of the ridge.

Thermal currents will considerably modify the previous effects, and may be produced in two ways. Above an area that is more strongly heated by the sun than its neighbourhood, there will be an upflow recognisable by the soaring of birds or the bump experienced by aircraft. Typical sites are a dry or rocky area, or a town surrounded by cultivation; the opposite occurs over a lake. Similar results are produced by the temperature contrasts between slopes facing the sun and those inclined away from it: in the tropics, up and down currents exceeding 5 ft./sec. are caused soon after sunrise in this way. The ground on the top of a hill in sunshine will be hotter than the

surrounding air at the same level, and this explains the frequent attainment by sailplanes of heights far in excess of those due to hill-lift alone. The heating of the air is due to conduction and is determined by the temperature of the ground: its power of radiating heat to the air is immaterial.

The second way in which thermal currents may form is to be found over a large flat area in which, owing to heating from below, the air conditions are unstable. The equilibrium breaks down by the formation of columns of uprush, with slow descent in the interspaces. If there is a slight breeze, these columns will move with it; but those of the first type would be anchored at their base and incline forwards with the breeze. The columns may extend high enough for condensation to occur. Isolated columns will then produce cumulus clouds, but columns of the second type tend to form in a geometrical pattern and the clouds are then strato-cumulus, arranged either in lines or in a rectangular pattern: in this last case, however, the pattern is at times not conspicuous and the clouds are wrongly classed as cumulus.

When vertical instability is combined with hill-lift, the joint effect depends on circumstances. Sometimes there is an eddy on the windward side of the hill with an area of down-draught as well as a bigger one of rising air; and sometimes the ordinary stationary eddy producing a descending current on the lee-side is replaced by a series of such eddies travelling with the wind.

Normally, in England the vertical temperature gradient is less than the unsaturated adiabatic of 10° C. in a kilometre; but it is usually greater than that of the saturated adiabatic of about 6° in a kilometre. Accordingly, if the uprush extends to the dewpoint level, it will thereafter meet with greater instability—as was indicated by Mr. Wills's upward air velocities of 7–9 ft./sec. below and 15–17 ft./sec. in the cloud. He agrees with me in thinking that up-currents adapted for soaring occur on days when the lapse rate is considerably less than the dry adiabatic. On August 5, the information available regarding upper air temperatures indicates a vertical gradient of only about 7° a kilometre: winds were also normal in type.

Naturally, up-currents are much stronger in the tropics than in temperate latitudes: accordingly, the German gliding expedition to Brazil found no difficulty in soaring to 5,000 ft., and on one occasion reached a height of 12,600 ft. Such soaring was only possible in a land-wind; a sea-wind brought in cold air below which led to greater stability and compelled immediate descent.

With reference to Mr. Collins's experience, the problem of cross-country flying turns on that of finding sufficient rising columns. One method is to soar as high as possible in an up-current (often called a 'stepping-stone') and then to glide nearly horizontally until another up-current is found; soaring is performed on that and the process repeated indefinitely. As the angle of descent should not exceed 1 in 15, a climb of 2,000 ft. means a horizontal distance of nearly six miles; and this should suffice for finding another 'stepping-stone'. A second method for a skilled pilot is to travel in the ascending air in front of a line squall as it moves across country. A third method was foreshadowed in one of the Royal Aeronautical Society's lectures in 1933, and consists in using the up-current under a longitudinal 'cell', that is, one of the long straight strato-cumulus rolls, usually parallel to the wind and now called by English gliders a 'wind-street'. This assists further search for 'stepping-stones', but the direction of travel is prescribed. If freedom in this respect is essential, the first method must be followed. Thus on July 15, Mr. Collins flew in a west-south-west wind from Dunstable to Hanworth, which lies south-south-east of the starting point, in a direction at right angles to the wind. One ingenious plan to lessen the trouble of finding 'thermals' is that of a distinguished pilot at Rossitten, who has trained hawks to accompany him in his flights; these unconsciously show him the up-currents which they employ.

On August 5, Mr. Collins started at 10.45 from the bowl at the north end of the Dunstable ridge and spent half an hour before a cloud enabled him to circle up a thousand feet. A series of clouds used as 'stepping-stones' are clearly indicated on the record of his 'altigraph', and by them at 11.30 he had reached a height of three thousand feet above his starting point. He then made use of a 'cloud-street', the altigraph showing a rhythmic series of ups and downs. More 'cloud-hopping' brought him to another 'cloud-street', which by 13.15 hr. was higher than the former and carried him along at a height of nearly five thousand feet. Having no parachute and not wishing to fly in the clouds, he had at one stage to travel at 70 m.p.h. to keep out of them. His downward glide lasted until he was at 1,500 ft.; he was then over sandy, dry heath and there found a 'thermal' which took him again to cloud level. The flight had to end when he reached the sea, and being still high he looped down, landing after 4½ hours in the air on the beach at Holkham Bay.

It would appear that most of the methods of using up-currents for cross-country flight have now been tackled. Perhaps the next problem is that of 'dynamical flight'—the use of variations in the horizontal velocity of the wind, as in the non-flapping flight of birds in gusty weather under overcast skies.

Obituary

PROF. M. S. PEMBREY, F.R.S.

MARCUS SEYMOUR PEMBREY succeeded Starling as professor of physiology at Guy's Hospital, London, in 1899 and retired after thirty-four years at that post last year. For most of this time he lived on a small farm in Sussex, which with little help but that of his family he worked himself. It was almost a principle with him that the physiological life could be lived only in the country, and even then only by those who, so far as possible, produce the food necessary for their own life. He seemed to enjoy the sturdiest of health and it was a great shock for his friends to hear of his death, at the age of sixty-eight years, in a nursing home at Oxford on July 23, barely a year since his retirement to a farm in Wychwood Forest on the Cotswolds.

Pembrey, after graduating in medicine at Oxford in 1892, worked with J. S. Haldane in Burdon Sanderson's laboratory for three years, and was then appointed lecturer in physiology in the Charing Cross Hospital Medical School, where he stayed until he went to Guy's four years later.

The work which Pembrey began with Haldane at Oxford he continued for some years after he moved to London; in fact, throughout his whole career the field in which he worked, though its boundaries grew, was essentially the same. In his early work, by weighing the carbonic acid expired, he studied the reaction of animals to changes in external temperature, and was able to trace the acquirement of the power of regulating body temperature. For this he compared the chick before hatching and at different intervals after it, and also new-born mammals and the same animals some days later.

Some of Pembrey's most interesting observations were on the respiratory activity of hibernating animals, dormice, bats, hedgehogs and marmots, during their sleep, during the process of waking and after it. He recorded the type of respiratory movements, the activity of respiratory exchange and the relation between the carbonic acid formed and oxygen used. This relation, the 'respiratory quotient', he found to be far lower during the winter sleep than was compatible with the complete oxidation of foods; some intermediate product of oxidation was retained in the body: on the other hand, during the period before the sleep came on, when the animal was putting on fat, it was higher than the oxidations alone could account for. He was convinced and stoutly maintained to the end that these facts necessitated the belief that, in the former condition, fat was being converted into glycogen and in the latter the converse change was occurring. These views he supported by many other experiments.

Later, Pembrey was one of the first to seize upon the methods introduced by Haldane and his pupils for obtaining alveolar air and collecting the whole expired air from a man in all sorts of circumstances, to study the respiratory activity of men during exertion, in the state of 'second wind', and also in various pathological conditions.

In 1898 Pembrey contributed two important chapters to Sharpey-Schafer's "Textbook of Physiology" on the chemistry of respiration and on animal heat respectively. These will always be valuable to students of nineteenth century physiology. They were subjects which he had even then made his own, and on which all his most important later work had direct bearing.

MR. J. W. E. HEATH

THE death occurred, on July 24, at Oxhey, Herts, after a brief illness, of Mr. John William E. Heath, at the age of seventy-eight years. A Londoner, he was born in 1856 at 33 Upper Gloucester Place, Dorset Square. He retired from staff duties at the Royal Institution in 1925, after forty-six years' service, which began with an engagement as a junior helper in the laboratory there, entering with some previous apprenticeship in assaying. In later times he acted as lecturer's assistant in the historic lecture theatre. Heath had in turn seen eight years' service with Prof. Tyndall, thirty-six years' with Sir James Dewar, and two years' with Sir William Bragg.

As the helper and advisor of two generations of the leading men of science in their lectures and accompanying experimental demonstrations at the Institution, it would be true to say that he was eminently successful. Of placid disposition, endowed with abounding patience, he was specially competent to carry out the varied duties falling within this particular sphere of work. Elected into the Chemical Society so far back as 1891, Heath's certificate for fellowship stated that he had had great experience as an assistant, and had given valuable aid in all the original investigations conducted at the Royal Institution for the previous ten years. The signatures appended were: James Dewar, F. A. Abel, G. D. Liveing, W. C. Roberts-Austen, Ludwig Mond.

Heath lost an eye in an explosion of a glass cylinder at the Royal Institution (about 1904), during the course of experimental work for the purification of helium (tediously accumulated from the 0·1 per cent source from the King's Well, Bath). This misfortune he bore with a calm philosophy, not unmixed with an amused sense of the impeachment of friends that one eye seemed to serve him equally as two. He had held an appointment as a gas examiner under the Hertfordshire County Council for an extended period, and was, in fact, at work in such capacity to within ten days of his death.

We regret to announce the following deaths:

Sir Edgeworth David, K.B.E., C.M.G., emeritus professor of geology in the University of Sydney, known for his work in the Antarctic and on the geology of Australia, on August 28, aged seventy-six years.

Prof. Carl Jensen, director of the Serum Laboratory in the Royal Danish Veterinary and Agricultural Institute, Copenhagen, a pioneer in cancer research, on September 3, aged seventy years.

News and Views

Prof. I. P. Pavlov, For.Mem.R.S.

WE join with men of science the world over in congratulating Prof. Pavlov on the attainment of his eighty-fifth birthday. His devotion to, and understanding of, physiology appear to have revealed to him the secret of normal living even under the adverse conditions of the changing political states of his native land. He looks upon the Revolution as a grand-scale physiological experiment, which everyone hopes will ultimately turn out as successfully as Pavlov's experiments. The son of a village priest, Ivan Petrovitch Pavlov was born on September 14, 1849, and qualified in medicine in 1879. Then began his physiological career, which happily still goes on. Possessing a highly critical, yet productive mind, his investigations were prosecuted with extreme care, and his findings have consequently withstood the test of time. His additions to the knowledge of the working of the living body are of considerable magnitude and of the first order of importance, not only to physiologists but also to medical men and psychologists. The possession of the rare combination of a keen intellect with surgical skill and mechanical ingenuity led to important discoveries in the normal processes of digestion.

PAVLOV realised at an early stage of his career that the mode of working of an organ in the normal living body may be quite a different affair from the behaviour of the same organ under artificial conditions of isolation in a strange medium. His studies were carried out on normal dogs and he exploited the natural appetite of dogs for his researches. After the preliminary operation of bringing the duct of a salivary gland to the outside of the cheek or neck, or arranging an external opening for the stomach, complete healing was ensured and the dogs taken home to be well cared for with the aid of his wife and children. The dogs were trained to allow the attachment of bottles for the collection of juices and to a sound-proof room fitted with many silent and ingenious devices, for example, pneumatically operated feeding tables. Always exercising the greatest care to eliminate extraneous factors, Pavlov achieved his aim of studying the effect of one cause at a time even in such a complicated machine as a healthy living dog. Pure gastric juice was made available, and the part played by nervous action on the composition and flow of digestive juices could be assessed. This led on to the analysis of the rôle of the higher centres of the nervous system in secretory activity and formed the test method in his investigation of conditioned reflexes. The latter constitutes one of the most valuable contributions to the understanding of the working of the brain, and is a great step forward in the placing of psychology on a scientific basis. Prof. Pavlov figured as a "Scientific Worthy" in our issue of January 3, 1925, when an article on his life and work by the late Prof. E. H. Starling was published.

George Bentham (1800-84)

SEPTEMBER 10 is the fiftieth anniversary of the death of George Bentham, whose "Genera Plantarum" is still regarded as the standard work on the subject. Born in 1800 at Stoke, near Portsmouth, Bentham (who was a nephew of Jeremy Bentham, the distinguished jurist) in his earlier years studied law and philosophy. Though called to the Bar, he soon abandoned law for botany. He was elected a fellow of the Linnean Society in 1828, and in the following year became honorary secretary of the Horticultural Society. He travelled extensively, making botanical collections, which he ultimately presented to the Herbarium at Kew. Between 1832 and 1836 he published his important "Labiatarum, Genera and Species". He became friendly with Sir Joseph Hooker, director of Kew Gardens, who assisted him in the compilation of his greatest work, the "Genera Plantarum", which appeared at intervals between 1865 and 1883. From 1854, he was engaged at Kew, working quietly and systematically at the description of flowering plants. Here he assisted in the preparation of floras of the British Colonies. Bentham's "Handbook of the British Flora" (published in 1858) is still the standard guide to the naming of the native plants of Great Britain. He tells us that he "amused himself by writing it before breakfast". He was president of the Linnean Society from 1861 until 1874, and was made a fellow of the Royal Society in 1864. In 1878, on the completion of his labours on the Australian flora, he was made C.M.G. He died at Kew.

Centenary of the Death of Thomas Telford

ON September 2, Sir Henry Maybury, president of the Institution of Civil Engineers, placed a wreath on the tomb of Telford in Westminster Abbey, while Mr. W. H. Budgett, divisional inspector in Scotland for the Ministry of Transport, placed a laurel wreath at the memorial seat at Westerkirk, Dumfriesshire. Born at Westerkirk in 1757, Telford was educated at the parish school, and when fourteen years old was apprenticed as a mason. Down to 1783 he was a workman employed in his native district of Eskdale. Leaving home, he studied architectural and structural design at Edinburgh, proceeding afterwards to London, when he embarked upon the career which ultimately brought him fame and honour. The Institution of Civil Engineers began to take shape in 1818, and on February 3, 1820, the group who were fostering a scheme of association resolved to ask Telford to become their first president. Telford accepted, and gave an inaugural address, providing his colleagues with much counsel for the future. At the same time, he presented a large collection of books and drawings with the object of founding a library. There is a fine portrait of Telford in the Institution's house at Great George Street, by Lane, showing him seated; in the background is a view of Menai Bridge. Most

of the exhibits of the Telford Centenary Exhibition in London have been re-arranged at Aberdeen for the benefit of members of the British Association.

Scientific Institutions in South Africa

At a meeting of the Royal Society of South Africa on June 20, Mr. L. Crawford read a paper on the South African Literary and Scientific Institution (1833–1857). The South African Literary Society was started in 1824; John Fairbairn and Thomas Pringle were two of its sponsors, but it encountered the hostility of the Governor, Lord Charles Somerset. He refused to grant it a licence and the project was dropped until 1829. The Society then began to hold meetings, papers were read and prizes offered for essays, one of these being limited to students of the South African College, founded in the same year. The South African Institution was founded also in 1829 on the same lines, and in 1832 the two societies amalgamated, becoming the South African Literary and Scientific Institution. Reports of the meetings and papers read appeared in the *South African Quarterly Journal*, but in 1835 that *Journal* came to an end and information about the later history of the Institution is difficult to find. The Institution's own minute books, etc., have disappeared. In 1834, Sir John Herschel arrived in South Africa. He was a strong supporter of the Institution during the four years he was there; for nearly three years he was president. He specially pressed the claims of meteorology on the Institution. In 1836 the *Cape Almanac* speaks of the rooms of the Institution and its Museum. After 1838 it is certain the Institution declined, so much that in 1850 John Fairbairn suggested in the *Commercial Advertiser* that a new Institution be formed and for permanence should be attached to the public library. This appeal met with no response. The Institution disappeared from the list of societies in the *Almanac and Annual Register* in 1858, so it may be taken that it came to an end in 1857, but from the first annual report of the South African Museum in 1856 it is learned that, in the previous year, what was left of its collections, books, etc., had been handed over to the Museum.

River Gauging

The agitation on behalf of the establishment of a national Inland Water Survey will be supported during the meeting of the British Association at Aberdeen by a series of demonstrations of the process of river gauging on the River Dee, which are being undertaken by Capt. W. N. McClean with the aid of his apparatus, employed on the survey of the Ness Basin, and apparatus used by Prof. S. M. Dixon in connexion with gaugings of the River Severn. The demonstrations will take place on September 11 and other dates, as may be found desirable, at Woodend, above the Cairnton Intake of the Aberdeen Water Supply, the water authority of Aberdeen having kindly co-operated in providing a site for the gaugings and by installing two water-level recorders at Cairnton and Cults. Woodend Reach is of the 'pool' type and about 200 feet in width at normal water level. The maximum surface velocity is expected to vary from 3 ft. per sec. at low water to 10 ft. per sec. on a normal flood. At low water the depth on the section is 3 ft. over the greater part with a deeper strip on the south side. The two types of gauging apparatus to be employed are (1) the Ness Basin type consisting of a ropeway, twin punts and stream-lined rod with current meter on the lower end, and (2) the Severn type, consisting of a ropeway with suspended current meter and sinker weight. A comparison of the two methods under identical conditions promises to provide useful data for inland water survey purposes.

A Survey of Aberdeen

For the Aberdeen meeting of the British Association, a pamphlet has been prepared entitled "A Scientific Survey of Aberdeen and District", and presented to all members. This marks a continuation of the policy adopted last year at Leicester. These slight volumes of uniform size and type are more convenient and, be it said, more useful than the varied and often ponderous handbooks that in former years were distributed at each centre of meeting. The new series gives a wealth of information without a bewildering mass of detail. Various authors have contributed to the work: Mr. J. McFarlane contributes a geographical introduction, followed by Prof. A. W. Gibb and Dr. A. Bremner on the geology, Prof. J. Ritchie on the animal life and Mr. A. MacGregor on the flora. A number of articles treat of archæology, agriculture and the various industries of the town and district. Many members will turn with interest to the chapters on the fishing and granite industries which have done so much for the modern development of Aberdeen. The article on the trades shows, however, that Aberdeen has various other thriving industries, some with obvious local associations such as shipbuilding and fertilisers and others of more recent development. A final chapter gives biographical notes on some of the better-known men of science associated with the north-east of Scotland.

Alcoholism and Male Mortality

An informative paper on this subject was read by Dr. Rudolf Bandel, of Nuremberg, before the recent International Congress on Alcoholism held on July 30–August 3 in London. Prof. Bandel stated that Hindhede in 1923 was the first to demonstrate the considerable fall in the male death rate in Denmark associated with the decrease in the consumption of alcohol brought about by the War. A similar fall in the male mortality along with decrease in alcohol consumption has been observed elsewhere, for example, in Germany, Belgium, Sweden, Hungary, the United States, and in a lesser degree in Switzerland, Holland and Norway. It was not so marked in the last three countries, because either, it is suggested, the decrease in alcohol consumption during the War was not so pronounced, or else the alcohol consumption before the War was not so high as in the other countries. On the other hand, in countries such as Italy and Spain, which did not reduce their alcohol consumption during the War, the male

mortality has not fallen but rather risen, especially in Spain, where the consumption of alcohol since 1919 has been very considerable. Population statistics show that the death rate of married men is less affected by the alcohol curve than that of widowers, divorced persons and unmarried men, who are all more susceptible to the influence of alcohol. Moreover, the specific mortality of Jews, whose sobriety is proverbial, scarcely fell at all as the result of reduced consumption during the War, in contrast with that of the Christian population of the same region in Prussia and at Budapest. Dr. Bandel also pointed out that remarkable variations might be found in the male mortality due to various causes under the influence of alcohol consumption, especially in the case of suicides and deaths from accidents, pneumonia, tuberculosis and diseases of the digestive organs.

Recent Archæological Exploration in Great Britain

THE month of August, as usual, has been fruitful in results of archæological exploration on sites in various parts of Great Britain. Among the more important, Dr. R. E. Mortimer Wheeler's excavation of the great earthwork of Maiden Castle provides abundant material bearing on the Roman and pre-Roman occupation of the site. The discovery of four gold coins of the fourth century and a gold ring as treasure trove have necessitated an inquest in which the Prince of Wales, as owner of the land, is interested. It is anticipated that these objects will be handed eventually to the Dorchester Museum for custody. Evidence of a stone age settlement has been found, and it is expected that the excavation of the ditch now being undertaken will throw light on the origin of the work. Another hill-fort site will be available for the inspection of members of the British Association attending the Aberdeen meeting. This is the prehistoric fort on Finavon Hill on the main road from Aberdeen to Forfar at the entrance of Strathmore, which recently has been under excavation by Prof. Gordon Childe. On the hill-top are the remains of ramparts, still 12 ft. in height, but which, it is estimated, once stood nearly 20 ft. high by 20 ft. thick. The stone coping exhibits the curious character of vitrification, due apparently to exposure to intense heat, occasionally found in these Scottish forts. In the course of the excavation, pottery, flint implements, spindle-whorls, broken animal bones and a little iron were found; but there is nothing which would make it possible to assign a date to the fort with any certainty. It is, however, thought to be pre-Roman, rather than Roman, in dating. A brief account of the exploration of the fort appears in the *Times* of August 30.

MORE satisfactory, though still not very precise, evidence of dating has been obtained in the excavation of a hill fort at Breddin Hill Camp, Montgomeryshire, where of three phases of occupation, two are certainly pre-Roman, while the latest is characterised by the occurrence of fragments of late Romano-British wares, probably made on the hill, though whether after the Roman evacuation is still undecided. In an account of this, the second, season's exploration in the *Times* of August 31, it is stated that, up to the present, work has concentrated on the main entrance to the camp, which is of a somewhat unusual type. It is an incurved entrance, but is complicated by the fact that a rampart leads down from it on either side of the road of approach. Near the gate, the stone walling had been reinforced by some form of timbering, the main posts resting in holes. There were no guard chambers. This gate was evidently pre-Roman and showed no signs of reconstruction. At the back of the incurve of the eastern rampart was a hut contemporary with it, and nearby was another and later hut, representing the second phase. This, the six post holes suggest, may have been circular in form. A potsherd of Early Iron Age type points to a pre-Roman dating. Trenches dug across two of the ancient field divisions revealed that here, as elsewhere in Britain, the cultivation terraces are the outcome of the methods of primitive agriculture on the hillside. When ploughing caused the soil to travel downhill, the low retaining walls were gradually heightened with stones.

Russian Studies of the Stratosphere

WE learn from an article by Prof. P. A. Molchanov in the *Moscow News* that the recent All-Union Conference for the Study of the Stratosphere decided to call an international conference, with the same objects, to meet in the U.S.S.R. in 1936, the date to be fixed in relation to the total solar eclipse. The Soviet conference of last spring was mainly devoted to a review of the present state of knowledge of the problems of the extra-tropospheric regions of the atmosphere, with some references to their relation to the meteorological processes of the troposphere. Molchanov dealt with exploration by *ballon sonde* and *radio sonde*, and with the rôle of the stratosphere as stabiliser in atmospheric processes. Andriev discussed acoustic methods of investigation, and attention was specially directed to the prominence of the warm sound-reflecting regions during the polar night, at heights believed to be of the order of 30 km., and therefore likely to be accessible to the *ballon sonde*. Andriev also laid stress on the existence of air masses of unequal densities in the stratosphere, and urged their closer study. Ionospheric problems were treated by Tverskoi, who discussed the sources of ionisation in the atmosphere, and Bontch-Bruewitch, who reviewed the results of experimental soundings of the ionosphere (NATURE, Feb. 3, 1934, p. 175). Special enthusiasm was shown in the section of the conference dealing with cosmic rays, Joffe, Skobeltzyn and Eigenson being among the speakers. Detailed discussion of the 'stratostat' and the stratospheric aeroplane occupied the technical section. The conference, under the presidency of Vavilov, passed resolutions dealing with the world conference, as already mentioned, and with the special need of co-operation among Soviet, American and Canadian scientific workers in polar atmospheric researches.

Scientific Research in the Building Trades

THE Department of Scientific and Industrial Research is presenting a building research exhibit at the Building Trades Exhibition to be held at Olympia on September 12–26. Most of the work has been carried out at the Building Research Station, Watford; the main exception being the timber portion of the exhibit, for which the Department's Forest Products Research Laboratory at Princes Risborough is responsible. The exhibit covers structural steel, plain and reinforced concrete, cement and cement products, natural stone, limes and plasters, brick and timber; codes of practice for the use of certain of these materials, and aspects of heating and lighting involved in securing comfortable conditions in a building. One of the chief researches is that dealing with steel-frame buildings, to which work the British Steel Work Association makes a substantial contribution. This work has already led to savings amounting to as much as twenty per cent in the cost of steelwork in steel-frame buildings. Various aspects of stone decay and the problems involved in the preservation, cleaning and restoration of stone structures are illustrated on the stand; methods of assessing the quality of samples of Portland stone by laboratory tests are also shown. An exhibit on brick and brick-masonry illustrates the procedure used to determine the strength of individual bricks and brick-masonry walls. The section dealing with heating, ventilation and natural lighting includes special instruments devised for comparing different methods of heating, the use of air spaces and metallic surfaces in providing thermal insulation, and the problem of the exclusion of solar heat.

Developing the Electric Grid System

Two important statements were made in the *Times* of August 28 concerning the electricity system of Great Britain. An electricity commissioner said that the completion of the grid system and its operation under the Central Electricity Board have solved the problem of bulk supply, but the problem of distribution still remains to be dealt with. The new electricity commissioner, Mr. J. M. Kennedy, was specially appointed to deal with the problem of distributing to the consumer. An official of the Central Electricity Board said that from the technical point of view the grid system is working satisfactorily. It has fully justified itself as an instrument for the efficient production of current and for bulk distribution. Extensive developments are in progress. Two of a series of five water-power plants being erected by a power company are now completed in Kirkcudbrightshire. They will supply millions of units per annum to the Grid for distribution in north-west England and central Scotland. The cost of tapping the Grid and installing a switching and transformer station a year or two ago was more than £20,000; one was recently completed in Northumberland at a cost of £6,000. He said that Great Britain is ahead of the world in domestic, commercial and rural electrification. Notwithstanding the great difference in population, there are more electric cookers in use in Great Britain than in the United States of America. In some parts of London, working-class houses of a rateable value of £18 a year are being fitted with electricity at the rate of 300 a week. The applications of electricity to industry are increasing rapidly.

International Conference on Soil Physics

A CONFERENCE of the First Commission (Soil Physics) of the International Society of Soil Science was held at the Centre de Recherches Agronomiques, Versailles, on July 2–5, under the presidency of Prof. G. W. Robinson, of Bangor. The programme, arranged in consultation with the French organising committee under the able direction of Dr. A. Demolon, included an official opening by the Minister of Agriculture, three paper-reading sessions with discussions, and a closing session. The communications and discussions covered the subjects of mechanical analysis and soil structure, moisture, colour and temperature. Resolutions embodying suggestions for future work were passed, and a committee was set up in association with the Society of Rheology to draw up a lexicon of terms used in soil physics in the principal European languages. In addition to the business programme, excursions were made to the College and Experiment Station at Grignon, sewage irrigation farms, and other objects of interest in the Seine valley. Entertainments were arranged, including a banquet at Saint Germain. At the conclusion of the Conference, the delegates made a short excursion in Alsace as guests of the Société Commerciale des Potasses d'Alsace. This excursion included a visit to the State potash mines at Mulhouse, tours in the Vosges and in the Colmar-Strasbourg district, during which palæo-loess and other soil profiles were examined, and a visit to the historic laboratory of Jean Baptiste Boussingault at Liebfrauenberg.

Commercial Timbers of Australia

SINCE the War, most States possessing forests of any importance have, owing to a greater world demand or greater competition, been engaged in an endeavour to place their commercial timbers on foreign markets; or, in some cases, in attempts to develop an interior market. Research officers have been studying the properties and uses of the principal commercial timbers of the country concerned with the object of providing purchasers and users with the necessary information in a concise form. Australia has been engaged on research in this direction at the Division of Forest Products. Pamphlet No. 47, "Properties of Australian Timbers (1)" (Government Printer, Melbourne, 1933) by H. E. Dadswell, has recently appeared. This first part of the series deals with the timbers of the genus *Eucalyptus* which are known as the 'Ash Group'. The real value of this type of research in most countries with forest resources is correctly enunciated by Mr. I. H. Boas, chief of the Division of Products: "Many Commercial timbers in Australia occur only

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The New World-Picture of Modern Physics

By Sir James H. Jeans, F.R.S., President of the British Association

Presidential address delivered at Aberdeen on September 5, 1934

THE British Association assembles for the third time in Aberdeen—under the happiest of auspices. It is good that we are meeting in Scotland, for the Association has a tradition that its Scottish meetings are wholly successful. It is good that we are meeting in the sympathetic atmosphere of a university city, surrounded not only by beautiful and venerable buildings, but also by buildings in which scientific knowledge is being industriously and successfully accumulated. It is especially good that Aberdeen is rich not only in scientific buildings but also in scientific associations. Most of us can think of some mastermind in his own subject who worked here. My own thoughts, I need scarcely say, turn to James Clerk Maxwell.

Whatever our subject, there is one man who will be in our thoughts in a very special sense to-night —Sir William Hardy, whom we had hoped to see in the presidential chair this year. It was not to be, and his early death, while still in the fulness of his powers, casts a shadow in the minds of all of us. We all know of his distinguished work in pure science, and his equally valuable achievements in applied science. I will not try to pay tribute to these, since it has been arranged that others, better qualified than myself, shall do so in a special memorial lecture. Perhaps, however, I may be permitted to bear testimony to the personal qualities of one whom I was proud to call a friend for a large part of my life, and a colleague for many years. Inside the council room, his proposals were always acute, often highly original, and invariably worthy of careful consideration; outside, his big personality and wide range of interests made him the most charming and versatile of friends.

Limitations of Theoretical Physics

Now I must turn to the subject on which I have specially undertaken to speak—the new world-picture presented to us by modern physics. It is a full half-century since this chair was last occupied by a theoretical physicist in the person of the late Lord Rayleigh, and in that interval theoretical physics has experienced many and revolutionary changes. The main edifice of science has grown almost beyond recognition, increasing in extent, dignity and beauty, as whole armies of labourers have patiently added wing after wing, story upon story, and pinnacle to pinnacle. Yet the theoretical physicist must admit that his own department looks like nothing so much as a building which has been brought down in ruins by a succession of earthquake shocks.

The earthquake shocks were, of course, new facts of observation, and the building fell because

it was not built on the solid rock of ascertained fact, but on the ever-shifting sands of conjecture and speculation. Indeed it was little more than a museum of models, which had accumulated because the old-fashioned physicist had a passion for trying to liken the ingredients of Nature to familiar objects such as billiard-balls, jellies and spinning tops. While he believed and proclaimed that Nature had existed and gone her way for countless æons before man came to spy on her, he assumed that the latest newcomer on the scene, the mind which could never get outside itself and its own sensations, would find things within its limited experience to explain what had existed from all eternity. It was expecting too much of Nature, as the ruin of our building has shown. She is not so accommodating as this to the limitations of the human mind; her truths can only be made comprehensible in the form of parables.

Yet no parable can remain true throughout its whole range to the facts it is trying to explain. Somewhere or other it must be too wide or too narrow, so that "the truth, the whole truth, and nothing but the truth" is not to be conveyed by parables. The fundamental mistake of the old-fashioned physicist was that he failed to distinguish between the half-truths of parables and the literal truth.

Perhaps his mistake was pardonable, perhaps it was even natural. Modern psychologists make great use of what they describe as 'word-association'. They shoot a word at you, and ask you to reply immediately with the first idea it evokes in your uncontrolled mind. If the psychologist says 'wave', the boy-scout will probably say 'flag', while the sailor may say 'sea', the musician 'sound', the engineer 'compression', and the mathematician 'sine' or 'cosine'. Now the crux of the situation is that the number of people who will give this last response is very small. Our remote ancestors did not survive in the struggle for existence by pondering over sines and cosines, but by devising ways of killing other animals without being killed themselves. As a consequence, the brains we have inherited from them take more kindly to the concrete facts of everyday life than to abstract concepts; to particulars rather than to universals. Every child, when first it begins to learn algebra, asks in despair "But what are x, y and z?" and is satisfied when, and only when, it has been told that they are numbers of apples or pears or bananas or something such. In the same way, the old-fashioned physicist could not rest content with x, y and z, but was always trying to express them in terms of apples or pears or bananas. Yet a simple argument will show that he can never get beyond x, y and z.

Physical science obtains its knowledge of the external world by a series of exact measurements, or, more precisely, by comparisons of measurements. Typical of its knowledge is the statement that the line $H\alpha$ in the hydrogen spectrum has a wave-length of so many centimetres. This is meaningless until we know what a centimetre is. The moment we are told that it is a certain fraction of the earth's radius, or of the length of a bar of platinum, or a certain multiple of the wave-length of a line in the cadmium spectrum, our knowledge becomes real, but at that same moment it also becomes purely numerical—a knowledge of the value of a ratio. Our minds can only be acquainted with things inside themselves—never with things outside. Thus we can never know the essential nature of anything, such as a centimetre or a wave-length, which exists in that mysterious world outside ourselves to which our minds can never penetrate; but we can know the numerical ratio of two quantities of similar nature no matter how incomprehensible they may both be individually.

For this reason, our knowledge of the external world must always consist of numbers, and our picture of the universe—the synthesis of our knowledge—must necessarily be mathematical in form. All the concrete details of the picture, the apples, the pears and bananas, the ether and atoms and electrons, are mere clothing that we ourselves drape over our mathematical symbols—they do not belong to Nature, but to the parables by which we try to make Nature comprehensible. It was, I think, Kronecker who said that in arithmetic God made the integers and man made the rest; in the same spirit, we may add that in physics God made the mathematics and man made the rest.

The modern physicist does not use this language, but he accepts its implications, and divides the concepts of physics into observables and unobservables. In brief, the observables embody facts of observation, and so are purely numerical or mathematical in their content; the unobservables are the pictorial details of the parables.

The physicist wants to make his new edifice earthquake-proof—immune to the shock of new observations—and so builds only on the solid

rock, and with the solid bricks, of ascertained fact. Thus he builds only with observables, and his whole edifice is one of mathematics and mathematical formulæ—all else is man-made decoration.

For example, when the undulatory theory had made it clear that light was of the nature of waves, the scientists of the day elaborated this by saying that light consisted of waves in a rigid, homogeneous ether which filled all space. The whole content of ascertained fact in this description is the one word 'wave' in its strictly mathematical sense; all the rest is pictorial detail, introduced to help out the inherited limitations of our minds.

Then scientists took the pictorial details of the parable literally, and so fell into error. For example, light-waves travel in space and time jointly, but by filling space and space alone with ether, the parable seemed to make a clear-cut distinction between space and time. It even suggested that they could be separated out in practice —by performing a Michelson-Morley experiment. Yet, as we all know, the experiment when performed only showed that such a separation is impossible; the space and time of the parable are found not to be true to the facts—they are revealed as mere stage scenery. Neither is found to exist in its own right, but only as a way of cutting up something more comprehensive—the space-time continuum.

Thus we find that space and time cannot be classified as realities of Nature, and the generalised theory of relativity shows that the same is true of their product, the space-time continuum. This can be crumpled and twisted and warped as much as we please without becoming one whit less true to Nature—which, of course, can only mean that it is not itself part of Nature.

In this way, space and time, and also their space-time product, fall into their places as mere mental frameworks of our own construction. They are of course very important frameworks, being nothing less than the frameworks along which our minds receive their whole knowledge of the outer world. This knowledge comes to our minds in the form of messages passed on from our senses; these in turn have received them as impacts or transfers of electro-magnetic momentum or energy. Now Clerk Maxwell showed that electromagnetic activity of all kinds could be depicted perfectly as travelling in space and time—this was the essential content of his electromagnetic theory of light. Thus space and time are of preponderating importance to our minds as the media through which the messages from the outer world enter the 'gateways of knowledge', our senses, and in terms of which they are classified. Just as the messages which enter a telephone exchange are classified by the wires along which they arrive, so the messages which strike our senses are classified by their arrival along the space-time framework.

Classical Physics

The classical physics, assuming that each message must have had a starting-point, postulated the existence of 'matter' to provide such starting-points. But the existence of this matter was a pure hypothesis; and matter is in actual fact as unobservable as the ether, Newtonian force, and other unobservables which have vanished from science. Early science not only assumed matter to exist, but further pictured it as existing in space and time. Again this assumption had no adequate justification; for there is clearly no reason why the whole material universe should be restricted to the narrow framework along which messages strike our senses. To illustrate by an analogy, the earthquake waves which damage our houses travel along the surface of the ground, but we have no right to assume that they originate in the surface of the ground; we know, on the contrary, that they originate deep down in the earth's interior.

The Newtonian mechanics, however, having endowed space and time with real objective existences, assumed that the whole universe existed within the limits of space and time. Even more characteristic of it was the doctrine of 'mechanistic determinism', which could be evolved from it by strictly logical processes. This reduced the whole physical universe to a vast machine in which each cog, shaft and thrust bar could only transmit what it received, and wait for what was to come next. When it was found that the human body consisted of nothing beyond commonplace atoms and molecules, the human race also seemed to be reduced to cogs in the wheel, and in face of the inexorable movements of the machine, human effort, initiative and ambition seemed to become meaningless illusions. Our minds were left with no more power or initiative than a sensitised cinematograph film; they could only register what was impressed on them from an outer world over which they had no control.

Theoretical physics is no longer concerned to study the Newtonian universe which it once believed to exist in its own right in space and time. It merely sets before itself the modest task of reducing to law and order the impressions that the universe makes on our senses. It is not concerned with what lies beyond the gateways of knowledge, but with what enters through the gateways of knowledge. It is concerned with appearances rather than reality, so that its task resembles that of the cartographer or map-maker rather than that of the geologist or mining engineer.

Now the cartographer knows that a map may be drawn in many ways, or, as he would himself say, many kinds of projection are available. Each one has its merits, but it is impossible to find all the merits we might reasonably desire combined in one single map. It is reasonable to demand that each bit of territory should look its proper shape on the map; also that each should look its proper relative size. Yet even these very reasonable requirements cannot usually be satisfied in a single map; the only exception is when the map is to contain only a small part of the whole surface of the globe. In this case, and this only, all the qualities we want can be combined in a single map, so that we simply ask for a map of the county of Surrey without specifying whether it is to be a Mercator's or orthographic or conic projection, or what not.

All this has its exact counterpart in the map-making task of the physicist. The Newtonian mechanics was like the map of Surrey, because it dealt only with a small fraction of the universe. It was concerned with the motions and changes of medium-sized objects—objects comparable in size with the human body—and for these it was able to provide a perfect map which combined in one picture all the qualities we could reasonably demand. But the inconceivably great and the inconceivably small were equally beyond its ken. As soon as science pushed out—to the cosmos as a whole in one direction and to sub-atomic phenomena in the other—the deficiencies of the Newtonian mechanics became manifest. No modification of the Newtonian map was able to provide the two qualities which this map had itself encouraged us to expect—a materialism which exhibited the universe as constructed of matter lying within the framework of space and time, and a determinism which provided an answer to the question "What is going to happen next?"

The Particle- and Wave-Parables

When geography cannot combine all the qualities we want in a single map, it provides us with more than one map. Theoretical physics has done the same, providing us with two maps which are commonly known as the particle-picture and the wave-picture.

The particle-picture is a materialistic picture which caters for those who wish to see their universe mapped out as matter existing in space and time. The wave-picture is a determinist picture which caters for those who ask the question "What is going to happen next?" It is perhaps better to speak of these two pictures as the particle-parable and the wave-parable. For this is what they really are, and the nomenclature warns us in advance not to be surprised at inconsistencies and contradictions.

Let me remind you, as briefly as possible, how this pair of pictures or parables have come to be in existence side by side.

The particle-parable, which was first in the field, told us that the material universe consists of particles existing in space and time. It was created by the labours of chemists and experimental physicists, working on the basis provided by the classical physics. Its time of testing came in 1913, when Bohr tried to find out whether the two particles of the hydrogen atom could possibly produce the highly complicated spectrum of hydrogen by their motion. He found a type of motion which could produce this spectrum down to its minutest details, but the motion was quite inconsistent with the mechanistic determinism of the Newtonian mechanics. The electron did not move continuously through space and time, but jumped, and its jumps were not governed by the laws of mechanics, but to all appearance, as Einstein showed more fully four years later, by the laws of probability. Of 1,000 identical atoms, 100 might make the jump, while the other 900 would not. Before the jumps occurred, there was nothing to show which atoms were going to jump. Thus the particle-picture conspicuously failed to provide an answer to the question "What will happen next?"

Bohr's concepts were revolutionary, but it was soon found they were not revolutionary enough, for they failed to explain more complicated spectra, as well as certain other phenomena.

Then Heisenberg showed that the hydrogen spectrum—and, as we now believe, all other spectra

as well—could be explained by the motion of something which was rather like an electron, but did not move in space and time. Its position was not specified by the usual co-ordinates x, y, z of co-ordinate geometry, but by the mathematical abstraction known as a matrix. His ideas were rather too abstract even for mathematicians, the majority of whom had quite forgotten what matrices were. It seemed likely that Heisenberg had unravelled the secret of the structure of matter, and yet his solution was so far removed from the concepts of ordinary life that another parable had to be invented to make it comprehensible.

The wave-parable serves this purpose; it does not describe the universe as a collection of particles but as a system of waves. The universe is no longer a deluge of shot from a battery of machine-guns, but a stormy sea with the sea taken away and only the abstract quality of storminess left—or the grin of the Cheshire cat if we can think of a grin as undulatory. This parable was not devised by Heisenberg, but by de Broglie and Schrödinger. At first they thought their waves merely provided a superior model of an ordinary electron; later it was established that they were a sort of parable to explain Heisenberg's pseudo-electron.

Now the pseudo-electron of Heisenberg did not claim to account for the spectrum emitted by a single atom of gas, which is something entirely beyond our knowledge or experience, but only that emitted by a whole assembly of similar atoms; it was not a picture of one electron in one atom, but of all the electrons in all the atoms. In the same way the waves of the wave-parable do not picture individual electrons, but a community of electrons—a crowd—as for example the electrons whose motion constitutes a current of electricity. In this particular instance the waves can be represented as travelling through ordinary space. Except for travelling at a different speed, they are very like the waves by which Maxwell described the flow of radiation through space, so that matter and radiation are much more like one another in the new physics than they were in the old.

In other cases, ordinary time and space do not provide an adequate canvas for the wave-picture. The wave-picture of two currents of electricity, or even of two electrons moving independently, needs a larger canvas—six dimensions of space and one of time. There can be no logical justification for identifying any particular three of these six dimensions with ordinary space, so that we must regard the wave-picture as lying entirely outside space. The whole picture, and the manifold dimensions of space in which it is drawn, become pure mental constructs—diagrams and frameworks we make for ourselves to help us understand phenomena.

Materialism or Determinism ?

In this way we have the two co-existent pictures—the particle-picture for the materialist, and the wave-picture for the determinist. When the cartographer has to make two distinct maps to exhibit the geography of, say, North America, he is able to explain why two maps are necessary, and can also tell us the relation between the two—he can show us how to transform one into the other. He will tell us, for example, that he needs two maps simply because he is restricted to flat surfaces—pieces of paper. Give him a sphere instead, and he can show us North America, perfectly and completely, on a single map.

The physicist has not yet found anything corresponding to this sphere; when, if ever, he does, the particle-picture and the wave-picture will be merged into a single new picture. At that moment, many of the major problems of physics will be solved, and many of the puzzles of philosophy as well. But at present some kink in our minds, or perhaps merely some ingrained habit of thought, prevents our understanding the universe as a consistent whole—just as the ingrained habits of thought of a 'flat-earther' prevent his understanding North America as a consistent whole. Yet, although physics has so far failed to explain why two pictures are necessary, it is, nevertheless, able to explain the relation between the particle-picture and the wave-picture in perfectly comprehensible terms.

The central feature of the particle-picture is the atomicity which is found in the structure of matter. But this atomicity is only one expression of a fundamental coarse-grainedness which pervades the whole of Nature. It crops up again in the fact that energy can only be transferred by whole quanta. Because of this, the tools with which we study Nature are themselves coarse-grained; we have only blunt probes at our disposal, and so can never acquire perfectly precise knowledge of Nature. Just as, in astronomy, the grain of our photographic plates prevents our ever fixing the position of a star with absolute

precision, so in physics we can never say that an electron is here, at this precise spot, or that it is moving at just such and such a speed. The best we can do with our blunt probes is to represent the position of the electron by a smear, and its motion by a moving smear which will get more and more blurred as time progresses. Unless we check the growth of our smear by taking new observations, it will end by spreading through the whole of space.

Now the waves of an electron or other piece of matter are simply a picture of just such a smear. Where the waves are intense, the smear is black, and conversely. The nature of the smear—whether it consists of printer's ink, or, as was at one time thought, of electricity—is of no importance; this is mere pictorial detail. All that is essential is the relative blackness of the smear at different places—a ratio of numbers which measures the relative chance of electrons being at different points of space.

The relation between the wave-picture and the particle-picture may be summed up thus: the more stormy the waves at any point in the wave-picture, the more likely we are to find a particle at that point in the particle-picture. Yet, if electrons really existed as the point-particles of the particle-picture, and the waves depicted the chances of their existing at different points of space—as Maxwell's law does for the molecules of a gas—then a gas would emit a continuous spectrum instead of the line-spectrum that is actually observed. Thus we had better put our statement in the form that the electron is not a point-particle, but that if we insist on picturing it as such, then the waves indicate the relative proprieties of picturing it as existing at the different points of space. But propriety relative to what?

The answer is—relative to our own knowledge. If we know nothing about an electron except that it exists, all places are equally likely for it, so that its waves are uniformly spread through the whole of space. By experiment after experiment we can restrict the extent of its waves, but we can never reduce them to a point, or indeed below a certain minimum; the coarse-grainedness of our probes prevents that. There is always a finite region of waves left. The waves which are left depict our knowledge precisely and exactly; we may say that they are waves of knowledge—or, perhaps even better still, waves of imperfections of knowledge—of the position of the electron.

Knowledge and Nature

Now we come to the central and most surprising fact of the whole situation. I agree that it is still too early, and the situation is still too obscure, for us fully to assess its importance, but, as I see it, it seems likely to lead to radical changes in our views not only of the universe but also even more of ourselves. Let us remember that we are dealing with a system of waves which depict in a graphic form our knowledge of the constituents of the universe. The central fact is this: the wave-parable does not tell us that these waves depict our knowledge of Nature, but that they are Nature itself.

If we ask the new physics to specify an electron for us, it does not give us a mathematical specification of an objective electron, but rather retorts with the question: "How much do you know about the electron in question?" We state all we know, and then comes the surprising reply, "That is the electron". The electron exists only in our minds—what exists beyond, and where, to put the idea of an electron into our minds we do not know. The new physics can provide us with wave-pictures depicting electrons about which we have varying amounts of knowledge, ranging from nothing at all to the maximum we can know with the blunt probes at our command, but the electron which exists apart from our study of it is quite beyond its purview.

Let me try and put this in another way. The old physics imagined it was studying an objective Nature which had its own existence independently of the mind which perceived it—which, indeed, had existed from all eternity whether it was perceived or not. It would have gone on imagining this to this day, had the electron observed by the physicists behaved as on this supposition it ought to have done. But it did not so behave, and this led to the birth of the new physics, with its general thesis that the Nature we study does not consist so much of something we perceive as of our perceptions; it is not the object of the subject-object relation, but the relation itself. There is, in fact, no clear-cut division between the subject and object; they form an indivisible whole which now becomes Nature. This thesis finds its final expression in the wave-parable, which tells us that Nature consists of waves and that these are of the general quality of waves of knowledge, or of absence of knowledge, in our own minds.

Let me digress to remind you that if ever we

are to know the true nature of waves, these waves must consist of something we already have in our own minds. Now knowledge and absence of knowledge satisfy this criterion as few other things could; waves in an ether, for example, emphatically did not. It may seem strange, and almost too good to be true, that Nature should in the last resort consist of something we can really understand; but there is always the simple solution available that the external world is essentially of the same nature as mental ideas.

At best this may seem very academic and up in the air—at the worst it may seem stupid and even obvious. I agree that it would be so, were it not for the one outstanding fact that observation supports the wave-picture of the new physics whole-heartedly and without hesitation. Whenever the particle-picture and the wave-picture have come into conflict, observation has discredited the particle-picture and supported the wave-picture—not merely, be it noted, as a picture of our knowledge of Nature, but as a picture of Nature itself. The particle-parable is useful as a concession to the materialistic habits of thought which have become ingrained in our minds, but it can no longer claim to fit the facts, and, so far as we can at present see, the truth about Nature must lie very near to the wave-parable.

Let me digress again to remind you of two simple instances of such conflicts and of the verdicts which observation has pronounced upon them. A shower of parallel-moving electrons forms in effect an electric current. Let us shoot such a shower of electrons at a thin film of metal, as Prof. G. P. Thomson did. The particle-parable compares it to a shower of hailstones falling on a crowd of umbrellas; we expect the electrons to get through somehow or anyhow and come out on the other side as a disordered mob. But the wave-parable tells us that the shower of electrons is a train of waves. It must retain its wave-formation, not only in passing through the film, but also when it emerges on the other side. And this is what actually happens: it comes out and forms a wave-pattern which can be predicted—completely and perfectly—from its wave-picture before it entered the film.

Next let us shoot our shower of electrons against the barrier formed by an adverse electromotive force. If the electrons of the shower have a uniform energy of ten volts each, let us throw them against an adverse potential difference of a million volts. According to the particle-parable, it is like throwing a handful of shot up into the air; they will all fall back to earth in time—the conservation of energy will see to that. But the wave-parable again sees our shower of electrons as a train of waves—like a beam of light—and sees the potential barrier as an obstructing layer—like a dirty window pane. The wave-parable tells us that this will check, but not entirely stop, our beam of electrons. It even shows us how to calculate what fraction will get through; and just this fraction, in actual fact, does get through; a certain number of ten-volt electrons surmount the potential barrier of a million volts—as though a few of the shot thrown lightly up from our hands were to surmount the earth's gravitational field and wander off into space. The phenomenon appears to be in flat contradiction to the law of conservation of energy, but we must remember that waves of knowledge are not likely to own allegiance to this law.

A further problem arises out of this experiment. Of the millions of electrons of the original shower, which particular electrons will get through the obstacle? Is it those who get off the mark first, or those with the highest turn of speed, or what? What little extra have they that the others haven't got?

It seems to be nothing more than pure good luck. We know of no way of increasing the chances of individual electrons; each just takes its turn with the rest. It is a concept with which science has been familiar ever since Rutherford and Soddy gave us the law of spontaneous disintegration of radioactive substances—of a million atoms ten broke up every year, and no help we could give to a selected ten would cause fate to select them rather than the ten of her own choosing. It was the same with Bohr's model of the atom; Einstein found that without the caprices of fate it was impossible to explain the ordinary spectrum of a hot body; call on fate, and we at once obtained Planck's formula, which agrees exactly with observation.

Determinism in Nature

From the dawn of human history, man has been wont to attribute the results of his own incompetence to the interference of a malign fate. The particle-picture seems to make fate even more powerful and more all-pervading than ever before; she not only has her finger in human affairs, but also in every atom in the universe.

The new physics has got rid of mechanistic determinism, but only at the price of getting rid of the uniformity of Nature as well!

I do not suppose that any serious scientist feels that such a statement must be accepted as final; certainly I do not. I think the analogy of the beam of light falling on the dirty window-pane will show us the fallacy of it.

Heisenberg's mathematical equation shows that the energy of a beam of light must always be an integral number of quanta. We have observational evidence of this in the photoelectric effect, in which atoms always suffer damage by whole quanta.

Now this is often stated in parable form. The parable tells us that light consists of discrete light-particles, called photons, each carrying a single quantum of energy. A beam of light becomes a shower of photons moving through space like the bullets from a machine-gun; it is easy to see why they necessarily do damage by whole quanta.

When a shower of photons falls on a dirty window-pane, some of the photons are captured by the dirt, while the rest escape capture and get through. Again the question arises: How are the lucky photons singled out? The obvious superficial answer is a wave of the hand towards Fortune's wheel; it is the same answer that Newton gave when he spoke of his 'corpuscles of light' experiencing alternating fits of transmission and reflection. But we readily see that such an answer is superficial.

Our balance at the bank always consists of an integral number of pence, but it does not follow that it is a pile of bronze pennies. A child may, however, picture it as so being, and ask his father what determines which particular pennies go to pay the rent. The father may answer "Mere chance"—a foolish answer, but no more foolish than the question. Our question as to what determines which photons gets through is, I think, of a similar kind, and if Nature seems to answer "Mere chance", she is merely answering us according to our folly. A parable which replaces radiation by identifiable photons can find nothing but the finger of fate to separate the sheep from the goats. But the finger of fate, like the photons themselves, is mere pictorial detail. As soon as we abandon our picture of radiation as a shower of photons, there is no chance but complete determinism in its flow; and the same is, I think, true when the particle-photons are replaced by particle-electrons.

We know that every electric current must transfer electricity by complete electron-units, but this does not entitle us to replace an electric current by a shower of identifiable electron-particles. Indeed the general principles of quantum-theory, which are in full agreement with observation, definitely forbid our doing so. When the red and white balls collide on a billiard table, red may go to the right and white to the left. The collision of two electrons A and B is governed by similar laws of energy and momentum, so that we might expect to be able to say that A goes to the right, and B to the left, or vice versa. Actually we must say no such thing, because we have no right to identify the two electrons which emerge from the collision with the two that went in. It is as though A and B had temporarily combined into a single drop of electric fluid, which had afterwards broken up into two new electrons, C, D. We can only say that after the collision C will go to the right and D to the left. If we are asked which way A will go, the true answer is that by then A will no longer exist. The superficial answer is that it is a pure toss-up. But the toss-up is not in Nature; it is in our own minds: it is an even chance whether we choose to identify C with A or with B.

Thus the indeterminism of the particle-picture seems to reside in our own minds rather than in Nature. In any case this picture is imperfect, since it fails to represent the facts of observation. The wave-picture, which observation confirms in every known experiment, exhibits a complete determinism.

Again we may begin to feel that the new physics is little better than the old—that it has merely replaced one determinism by another. It has; but there is all the difference in the world between the two determinisms. For in the old physics the perceiving mind was a spectator; in the new it is an actor. Nature no longer forms a closed system detached from the perceiving mind; the perceiver and perceived are interacting parts of a single system. The Nature depicted by the wave-picture in some way embraces our minds as well as inanimate matter. Things still change solely as they are compelled, but it no longer seems impossible that part of the compulsion may originate in our own minds.

Even the inadequate particle-picture told us something very similar in its own roundabout stammering way. At first it seemed to be telling us of a Nature distinct from our minds, which

moved as directed by throws of the dice, and then it transpired that the dice were thrown by our own minds. Our minds enter into both pictures, although in somewhat different capacities. In the particle-picture the mind merely decides under what conventions the map is to be drawn; in the wave-picture it perceives and observes and draws the map. We should notice, however, that the mind enters both pictures only in its capacity as a receptacle—never as an emitter.

The determinism which appears in the new physics is one of waves, and so, in the last resort, of knowledge. Where we are not ourselves concerned, we can say that event follows event; where we are concerned, only that knowledge follows knowledge. Even this knowledge is one only of probabilities and not of certainties; it is at best a smeared picture of the clear-cut reality which we believe to lie beneath. And just because of this, it is impossible to decide whether the determinism of the wave-picture originates in the underlying reality or not—Can our minds change what is happening in reality, or can they only make it look different to us by changing our angle of vision? We do not know, and as I do not see how we can ever find out, my own opinion is that the problem of free-will will continue to provide material for fruitless discussion until the end of eternity.

The contribution of the new physics to this problem is not that it has given a decision on a long-debated question, but that it has reopened a door which the old physics had seemed to slam and bolt. We have an intuitive belief that we can choose our lunch from the menu or abstain from housebreaking or murder; and that by our own volition we can develop our freedom to choose. We may, of course, be wrong. The old physics seemed to tell us that we were wrong, and that our imagined freedom was all an illusion; the new physics tells us it may not be.

The old physics showed us a universe which looked more like a prison than a dwelling-place. The new physics shows us a building which is certainly more spacious, although its interior doors may be either open or locked—we cannot say. But we begin to suspect it may give us room for such freedom as we have always believed we possessed; it seems possible at least that in it we can mould events to our desire, and live lives of emotion, intellect and endeavour. It looks as though it might form a suitable dwelling-place for man, and not a mere shelter for brutes.

Philosophical Implications

The new physics obviously carries many philosophical implications, but these are not easy to describe in words. They cannot be summed up in the crisp, snappy sentences beloved of scientific journalism, such as that materialism is dead, or that matter is no more. The situation is rather that both materialism and matter need to be redefined in the light of our new knowledge. When this has been done, the materialist must decide for himself whether the only kind of materialism which science now permits can be suitably labelled materialism, and whether what remains of matter should be labelled as matter or as something else; it is mainly a question of terminology.

What remains is in any case very different from the full-blooded matter and the forbidding materialism of the Victorian scientist. His objective and material universe is proved to consist of little more than constructs of our own minds. To this extent, then, modern physics has moved in the direction of philosophic idealism. Mind and matter, if not proved to be of similar nature, are at least found to be ingredients of one single system. There is no longer room for the kind of dualism which has haunted philosophy since the days of Descartes.

This brings us at once face to face with the fundamental difficulty which confronts every form of philosophical idealism. If the Nature we study consists so largely of our own mental constructs, why do our many minds all construct one and the same Nature? Why, in brief, do we all see the same sun, moon and stars?

I would suggest that physics itself may provide a possible although very conjectural clue. The old particle-picture, which lay within the limits of space and time, broke matter up into a crowd of distinct particles, and radiation into a shower of distinct photons. The newer and more accurate wave-picture, which transcends the framework of space and time, recombines the photons into a single beam of light and the shower of parallel-moving electrons into a continuous electric current. Atomicity and division into individual existences are fundamental in the restricted space-time picture, but disappear in the wider, and as far as we know more truthful, picture which transcends space and time. In this, atomicity is replaced by what General Smuts would describe as 'holism'—the photons are no longer distinct individuals each going its own way, but members

of a single organisation or whole—a beam of light. The same is true, *mutatis mutandis*, of the electrons of a parallel-moving shower. The biologists are beginning to tell us, although not very unanimously, that the same may be true of the cells of our bodies. And is it not conceivable that what is true of the objects perceived may be true also of the perceiving minds ? When we view ourselves in space and time we are quite obviously distinct individuals ; when we pass beyond space and time we may perhaps form ingredients of a continuous stream of life. It is only a step from this to a solution of the problem which would have commended itself to many philosophers, from Plato to Berkeley, and is, I think, directly in line with the new world-picture of modern physics.

Scientific Progress and Civilisation

I have left but little time to discuss affairs of a more concrete nature. We meet in a year which has to some extent seen science arraigned before the bar of public opinion ; there are many who attribute most of our present national woes—including unemployment in industry and the danger of war—to the recent rapid advance in scientific knowledge.

Even if their most lurid suspicions were justified, it is not clear what we could do. For it is obvious that the country which called a halt to scientific progress would soon fall behind in every other respect as well—in its industry, in its economic position, in its naval and military defences, and, not least important, in its culture. Those who sigh for an Arcadia in which all machinery would be scrapped and all invention proclaimed a crime, as it was in Erewhon, forget that the Erewhonians had neither to compete with highly organised scientific competitors for the trade of the world nor to protect themselves against possible bomb-dropping, blockade or invasion.

But can we admit that the suspicions of our critics are justified ? If science has made the attack more deadly in war, it has also made the defence more efficient ; in the long run it shows no partiality in the age-long race between weapons of attack and defence. This being so, it would, I think, be hard to maintain in cold blood that its activities are likely to make wars either more frequent or more prolonged. It is at least arguable that the more deadly a war is likely to be, the less likely it is to occur.

Still it may occur. We cannot ignore the tragic fact that, as our President of two years ago told us, science has given man control over Nature before he has gained control over himself. The tragedy does not lie in man having so much scientific control over Nature, but in his having so little moral control over himself. Yet it is only one chapter of a long story—human nature changes very slowly, and so for ever lags behind human knowledge, which accumulates very rapidly. The plays of Æschylus and Sophocles still thrill us with their vital human interest, but the scientific writings of Aristarchus and Ptolemy are dead—mere historical curiosities which leave us cold. Scientific knowledge is transmitted from one generation to another, while acquired characteristics are not. Thus in respect of knowledge each generation stands on the shoulders of its predecessor, but in respect of human nature both stand on the same ground.

These are hard facts which we cannot hope to alter, and which—we may as well admit—may wreck civilisation. If there is an avenue of escape, it does not, as I see it, lie in the direction of less science, but of more science—psychology, which holds out hopes that for the first time in his long history, man may be enabled to obey the command 'Know thyself' ; to which I, for one, would like to see adjoined a morality and if possible even a religion, consistent with our new psychological knowledge and the established facts of science ; scientific and constructive measures of eugenics and birth control ; scientific research in agriculture and industry, sufficient at least to defeat the gloomy prophecies of Malthus and enable ever larger populations to live in comfort and contentment on the same limited area of land. In such ways we may hope to restrain the pressure of population and the urge for expansion which, to my mind, are far more likely to drive the people of a nation to war than the knowledge that they—and also the enemies they will have to fight—are armed with the deadliest weapons which science can devise.

This last brings us to the thorny problem of economic depression and unemployment. No doubt a large part of this results from the War, national rivalries, tariff barriers, and various causes which have nothing to do with science, but a residue must be traced to scientific research ; this produces labour-saving devices which in times of depression are only too likely to be welcomed as wage-saving devices, and to put men out of work. The scientific robot in *Punch's* cartoon

boasted that he could do the work of 100 men, but gave no answer to the question—"Who will find work for the displaced 99 ?" He might, I think, have answered—"The pure scientist, in part at least." For scientific research has two products of industrial importance—the labour-saving inventions which displace labour, and the more fundamental discoveries which originate as pure science, but may ultimately lead to new industries and new popular demands providing employment for vast armies of labour.

Both are rich gifts from science to the community. The labour-saving devices lead to emancipation from soul-destroying toil and routine work, to greater leisure and better opportunities for its enjoyment. The new inventions add to the comfort and pleasure, health and wealth of the community. If a perfect balance could be maintained between the two, there would be employment for all, with a continual increase in the comfort and dignity of life. But, as I see it, troubles are bound to arise if the balance is not maintained, and a steady flow of labour-saving devices with no accompanying steady flow of new industries to absorb the labour they displace, cannot but lead to unemployment and chaos in the field of labour.

At present we have a want of balance resulting in unemployment, so that our great need at the moment is for industry-making discoveries. Let us remember Faraday's electromagnetic induction, Maxwell's Hertzian waves, and the Otto cycle—each of which has provided employment for millions of men ; and, although it is an old story, let us also remember that the economic value of the work of one scientist alone, Edison, has been estimated at three thousand million pounds.

Unhappily, no amount of planning can arrange a perfect balance. For as the wind bloweth where it listeth, so no one can control the direction in which science will advance ; the investigator in pure science does not know himself whether his researches will result in a mere labour-saving device or a new industry. He only knows that if all science were throttled down, neither would result ; the community would become crystallised in its present state, with nothing to do but watch its population increase, and shiver as it waited for the famine, pestilence or war which must inevitably come to restore the balance between food and mouths, land and population.

Is it not better to press on in our efforts to secure more wealth and leisure and dignity of life for our own and future generations, even though we risk a glorious failure, rather than accept inglorious failure by perpetuating our present conditions, in which these advantages are the exception rather than the rule ? Shall we not risk the fate of that over-ambitious scientist Icarus, rather than resign ourselves without an effort to the fate which has befallen the bees and ants ? Such are the questions I would put to those who maintain that science is harmful to the race.

Summaries of Addresses of Presidents of Sections*

Theories of Light

In his presidential address to Section A (Mathematical and Physical Sciences), Prof. H. M. Macdonald discusses the development of theories of light. From early times, theories of light appear to have taken two forms; emission theories which ascribe the phenomena of light to emanations from the objects seen, and undulatory theories which ascribe the phenomena to undulations or pulsations proceeding from the object to the eye. With the revival of learning in the fifteenth and sixteenth centuries, both types of theory reappeared. The form of emission theory which was adopted ultimately was that due to Newton, known as the corpuscular theory of light; in it the emanations consist of small particles of matter emitted from the body. The form of undulatory theory adopted was that due to Huygens; this theory postulates an elastic medium which pervades all space, and light is assumed to be due to undulations propagated in this medium. At the beginning of last century, the corpuscular theory of light was the theory which was accepted almost universally, but the application of the principle of interference due to Young and Fresnel removed what had been until then regarded as an insuperable objection to an undulatory theory, its supposed inability to account for shadows.

Fresnel's principle of transversality, which was suggested or confirmed by the discovery that light polarised in perpendicular planes did not interfere, led to the relations between the amplitudes of the incident, reflected and transmitted waves of light passing from one isotropic medium to another, and also to the laws of propagation of light in crystalline media.

The development of mathematical analysis made it possible to submit the theory that light is due to undulations in an elastic medium to mathematical treatment. This was effected independently by Cauchy and by Green: Green's "Memoir on the Reflection and Refraction of Light" is specially noteworthy as being the first case of the application of Lagrange's dynamical method of treating a physical problem. Somewhat later, both writers discussed the case of crystalline media, with the result that an elastic medium which was self-contained did not give results which accorded with Fresnel's relations.

The next important stage in the development of theories of light is the hypothesis advanced by Faraday in his memoir on the rotation of the plane of polarisation by a magnetic field, that the phenomena of light, electricity and magnetism have a common origin. In 1865, Maxwell applied the Ampère-Faraday laws to the propagation of a magnetic disturbance in a non-conducting medium and showed that, on certain assumptions as to the nature of the medium, the electric and magnetic forces are in the wave front and the velocity of propagation in free space is the number of electrostatic units in an electromagnetic unit of electricity.

Starting from Faraday's hypothesis that light, electricity and magnetism have a common origin, the propagation of an electrical disturbance in free space will be subject to Fresnel's law of transversality; if this is combined with the Ampère-Faraday laws which give the relations between electric current and magnetic force and between magnetic current and electric force, it follows that an electrical disturbance is propagated in free space with a velocity equal to the velocity by which an electric charge expressed in electromagnetic units must be multiplied to convert it into electrostatic units.

On the above hypothesis, the effect of the presence of matter can be represented by a distribution of electric and magnetic currents throughout the space occupied by the matter. When no disturbance is being propagated, the states of motion corresponding to the currents which represent the effect of the matter will be steady, and if the effect of the disturbance is to set up oscillations about these steady states of motion, the material medium can be regarded as being transparent to the disturbance. Fresnel's results for isotropic and for crystalline media follow, and also Faraday's result for the rotation of the plane of polarisation by a magnetic field.

Physical Methods in Chemistry

Prof. T. M. Lowry, in his presidential address to Section B (Chemistry), points out that, after a period of dangerous separation, the interpenetration of chemistry and physics, as illustrated by the work of Aston in the Cavendish Laboratory and of Lennard-Jones in the Chemical Laboratory at Cambridge, is now an important factor in the development of both sciences.

The principal contributions of physics to chemical science in recent years have been based upon the discovery of atomic numbers, since this has provided a secure basis both for the classification of the elements and for the theory of valency. Isotopes and radioactivity also find a natural place in the system thus developed. Recent work on nuclear structure

* The collected presidential addresses at Aberdeen are being published under the title: "The Advancement of Science, 1934". (Aberdeen: B.A. Reception Room; London: Burlington House.) 3*s.* 6*d.*

and disintegration is of less immediate importance to chemists, but is obviously more fundamental than work on the electrons which envelop the nucleus.

Nearly forty years ago, observations of optical rotatory power led to the discovery of *mutarotation* in freshly prepared solutions of nitrocamphor in a large range of non-aqueous solvents, and to the interpretation of this phenomenon as an example of *dynamic isomerism*. The discovery of the arrest of mutarotation in chloroform showed that the isomeric change of nitrocamphor is not spontaneous, and later observations showed that an amphoteric solvent is required to promote the migration of a hydrogen atom in the prototropic change, for example, of the reducing sugars. Mutarotation is thus linked to the conception of acids and bases as donors and acceptors of a proton which was put forward by Lowry and then by Brönsted in 1923.

Measurements over a wide range of wave-lengths have shown that the normal rotatory dispersion of many organic compounds can be expressed by one term of Drude's equation, whilst anomalous rotatory dispersion, for example, in ethyl tartrate, can be expressed by two terms of opposite sign. The classification as *simple* of those dispersions which can be represented by one term, and as *complex* of those which require more than one term, is an important step in the analysis of optical rotatory power. Rotatory dispersion in absorbing media is a more complicated phenomenon, but an important simplification occurs in tetra-acetyl-μ-arabinose and in penta-acetyl-μ-fructose, where the partial rotations due to the asymmetric carbon atoms appear to cancel out, so that the whole of the rotatory power is due to the induced dissymmetry of the carbonyl group, the partial rotation of which is thus automatically isolated in the region of absorption, where the Cotton phenomena are observed, as well as in the region of transparency.

Recent work on the prediction of the sign and magnitude of optical rotations is discussed in the final section of the address.

Plant Life and the Philosophy of Geology

In the opening of his presidential address to Section C (Geology) Prof. W. T. Gordon directs attention to the tendency in science for the effects of discovery to be hidden by the further results that have accrued from the application of that self-same discovery. This is particularly true of the study of fossil plants. At present there is a feeling amongst geologists that such studies are not particularly important to them, and one has to admit the truth of that contention from some viewpoints. But there is a wider aspect. and some of the general principles of geology, now accepted as axiomatic and even affecting the general philosophy of the times, are directly or indirectly established through the medium of fossil plants.

In following out this idea, Prof. Gordon notes the attitude of classical authors, so far as can be ascertained, towards geological phenomena, and mentions the great dearth of works on geology throughout the period of the Christian dispensation until the beginning of last century. Yet during the latter part of that period, the principle that fossils, in the modern sense, had once formed parts of plants or animals had been established, and the earlier works of Hooke and La Hire on the microscopic structure of fossil wood had materially assisted in this. Workers prior to their time had certainly accepted fossils as of organic origin, but the position was not generally conceded.

One stumbling-block was the occurrence of fossils far removed from their normal habitat and deeply buried in mines, and animals, rather than plants, were employed in advocating a great universal deluge in explanation of this phenomenon. But, accepting such a view, several authors in the late seventeenth and eighteenth centuries, Woodward, Scheuchzer, Parsons, among others, attempted to fix the season of the year in which the deluge had occurred by arguments based on fossil plants, and unconsciously showed the inadequacy of the theory in a most glaring fashion. The hypothesis had to be abandoned and was replaced by another, again largely established by means of fossil plants, namely, that fossils had existed under conditions quite different from the present. Although the notion had been taught in rather earlier days, it was the publication of works on fossil plants that first placed it before the general public. Consequently Brongniart was quite accurate when he stated that the study of fossil plants had saved the science from some of its more fantastic ideas.

Continuing, Prof. Gordon shows how several distinct floras have been delimited and used in the determination of the age of the rocks containing them, though the extent of the zones is wider than can be ascertained by animal types. In special cases plants alone can be employed, however, and recent research is giving indications along more than one line, that there are possibilities of employing plants as stratigraphical indexes in the future.

Finally, Prof. Gordon deals briefly with the question of fossil plants in relation to climatic differentiation. There is great need of closer co-operation among those interested to secure adequate mutual understanding and criticism in order that any theories advocated may be both necessary and sufficient. For the purpose of

discussions on past climates, plants alone appear to be of much value, though animals can be used in certain cases. The big trees of America have been examined to discover changes in climate during the recent past, and a careful selection of the type of tree to be used as an 'index' has been shown to be necessary; but, having made such a selection, consistent results have been obtained. While, at present, only a few thousand years can be covered by this line of research, the future may show that the determination of influences producing rhythmic changes in the growth rings of fossil trees is possible.

The Study of Behaviour

In his presidential address to Section D (Zoology), Dr. E. S. Russell points out that the study of animal behaviour has been somewhat neglected in Great Britain; it has become largely divorced from zoology and handed over to the physiologist and the psychologist, neither of whom is as a rule sufficient of a naturalist to appreciate fully the biological significance of the behaviour observed in the laboratory. The study of behaviour has accordingly not taken its rightful place as an essential part of zoology, either in research or in teaching.

One main cause of this unsatisfactory state of affairs is the continued influence on biology of the classical doctrine of materialism, with its absolute separation of matter and mind, which we owe primarily to Descartes. The living thing is regarded as a mechanism; its behaviour is a subject for the physiologist to study from his analytical point of view; under the influence of this metaphysical theory, he must regard behaviour as the causally determined outcome of the working of the animal machine, actuated by external and internal stimuli. The physiologist as such can have nothing to do with mind, and hands over its study to the psychologist, who finds that he can know nothing directly about the minds of animals.

Dr. Russell puts forward the view that both matter and mind are highly abstract notions, and should be replaced for the purposes of biology by the more concrete concept of organism. Like other natural units, the organism is a system, but it is distinguished from inorganic systems in that it shows the activities of maintenance, development and reproduction, bound up in one continuous life-cycle. A static concept of organism is inadequate; time must enter into the definition; the organism is essentially a "dynamic pattern in time" (Coghill).

All the activities of the organism are, objectively considered, directed towards an end, which is the completion of the normal life-cycle. Behaviour is simply one form of the general directive activity of the organism—that phase of it which is concerned with the relations of the organism to its external world. From this point of view, there is no need to separate life from mind; the relation of behavioural or 'psychological' activities to physiological may be regarded, not as the relation of mental to physical happenings, but, for the practical purposes of study, as the relation of a whole directive activity to its parts.

Dr. Russell then applies this organismal method, which in many ways approaches the Aristotelian, to the practical study of animal behaviour. He lays stress upon the importance of determining exactly what it is to which animals respond, and adduces evidence that response may be to patterns or relations or images, rather than to a simple summation of physico-chemical stimuli. Much of animal behaviour is not determined by external stimulation at all, but is a response to needs or deviations from the normal state.

Co-operative Research in Geography

Current geographical generalisation in regard to a large proportion of the earth's land surface necessarily derives from somewhat scanty data, often still representing the observations of the primary explorers. Prof. A. G. Ogilvie, in his presidential address to Section E (Geography), entitled "Co-operative Research in Geography; with an African Example", suggests a way of accelerating the process of gathering the type of information needed for the composition of geographical syntheses at least fuller and better than those which exist. In respect of the geography of man in such regions, this may be accomplished by utilising to the full the special local knowledge of European or other educated inhabitants of the regions. It is admitted that little help can be anticipated from this source where the fundamental facts of physical geography are concerned, for these must be established by observers trained in the various natural sciences. But, on the other hand, the requisite facts of human geography can be recorded effectively by untrained local observers, if they can be enabled to appreciate the kind of data that are needed. Even here, however, the success of any systematic inquiry depends partly upon the existence of reliable topographic maps. For this reason, the colonies and dependencies of the more advanced nations offer perhaps the most fruitful field for geographical research in the near future, in view of the justifiable hope of rapid extension of regular surveys in such countries.

Proof of this contention lies in the success of the effort inaugurated by a committee of the British Association, appointed in 1926 to investigate the

state of knowledge of the human geography of Inter-tropical Africa. This committee, which issued to selected persons throughout Africa a *questionnaire* dealing with specific aspects of local environment as affecting the material life of the native, has recently received very full replies to its questions from the District officers of Northern Rhodesia. These reports, voluminous in the aggregate, yield material for the first comprehensive view of the real relationship between the natives and their land in this Protectorate. Prof. Ogilvie, after sketching the physical background of the region, devotes the bulk of his address to a synthetic summary of certain aspects upon which new information is thus available.

The distribution of the population is revealed in relation to those of water and of woodland, upon which the natives are so largely dependent for wood ash as manure. Tsetse areas are defined, and the relative importance of cattle, in the parts remaining free, is made clear. The various staple crops are seen to have a definite relationship, in their distribution, to the soil conditions on one hand and to external influences on the other. These latter vary in degree throughout the country. The approximate volume, direction and character of the annual migration of native labour to European centres may now be appreciated. The annual rhythm of work and occupation as determined by the seasonal rainfall and variation of river flow can be clearly discerned, with its regional differences.

Other African territories will, it is to be hoped, soon yield data as full as these from Northern Rhodesia, and this mode of investigation might usefully be extended to other continents.

Future of Rail Transport

In his presidential address to Section F (Economic Science and Statistics), Prof. H. M. Hallsworth discusses "The Future of Rail Transport". At the present time, the established position of the railways is being assailed. Competition by road has taken on a new form, coastwise traffic has increased, and the air has been opened up as a third competitor. In view of these developments, what is the future position of the railways likely to be? Are they to be displaced from their position as the chief mode of transport, to which the rest are supplementary, and to be relegated to a position of secondary importance in the transport system of the twentieth century?

An 'ideal distribution' of traffic would provide for an economically sound division of function between road, rail and other forms of transport and would take into account, not only the price to the consumer and the cost to the operator, but also the ultimate real cost to the community. The difficulties of determining such true costs, however, are very great and especially so in the case of both rail and road transport.

Many railway critics advocate a solution of the problem by an alteration in the present (statutory) system of charging, but a real solution does not seem possible along these lines or by any system of division of road and rail into areas or spheres of function. By the Road and Rail Traffic Act, 1933, the railways are now permitted to make "agreed charges" with individual traders, and the result of a large extension of the system will undoubtedly be still greater competition with road hauliers, much of which would be wasteful to the community. The traders are on the horns of a dilemma. They cannot ask that the railways should be tied to their former methods of charging, while they themselves are free to choose road transport when it suits them to do so or when it is less expensive to use the roads.

The best solution is that the railways should come to be regarded as transport companies, undertaking a given piece of transport by that means or combination of means which appears to them to be the most economic, and at the same time, most suited to meet the real demand of the traveller or trader. It would be in their own interests to effect transit in each case by the most economic method, since otherwise their own net revenue would be diminished. The interests of the community might be safeguarded by the principle of limitation of profits and by the transformation of the Railway Rates Tribunal into a supervisory authority. Despite the development of new forms of transport, railways are likely to remain the backbone of the transport services of Great Britain for many years to come, though to meet modern requirements they need to be supplemented by other means of transport; this can be done most effectively and economically when the different modes of transport are under one management.

Sources of Cheap Electric Power

The president of Section G (Engineering), Prof. Francis G. Baily, devotes his address to the consideration of sources of cheap electric power.

In the winning of coal, a residue of some six per cent is left, as too poor to be worth carriage to consumers, but if consumed to produce electric power at the pit head, it affords a cheap and effective fuel. Its use will render more advantageous some methods of winning and cleaning which, though low in cost of operating, produce a large proportion of waste. The total amount thus made available is not less than 18,000,000 tons

per annum, some fifty per cent more than the entire electric supply industry uses to-day. Formerly, the lack of condensing water has been urged against pit head stations, but higher steam pressures and improved cooling towers have made this disability of small account. Another source of cheap power may be found in the factories which use large quantities of low-pressure steam. If this steam is produced at high pressure and put through turbines, it can be released at a suitable low pressure for factory use, and the electric power is obtained at very low cost.

Hitherto, these sources have been little exploited for general supply, as the pits and factories in Great Britain are not usually centrally placed, and means of distribution from them have not been readily available. The construction of the great network of high-tension wires, known as the grid, allows of all such sources being connected, and it can distribute with very small loss and cost to considerable distances. If a line be drawn some forty miles distant from the edge of the coal areas, nearly the whole of the country south of a line from Montrose to Arrochar in Scotland, and north of a line from Hull to Bournemouth is included, and the area contains two thirds of the population and most of the industries. Hence these sources are well placed for supply, and the grid and subsidiary lines will then form not only a great distributing agent, but also a great collector from all sources. The cost of distribution has been so much reduced that it is considerably cheaper to transmit power electrically than to carry the equivalent coal by rail. Only ship carriage of coal of good quality from pits near the coast to coast towns at a distance can compete with electric transmission.

While the hydro-electric stations in Scotland come into the scheme, for most of them the high cost of construction raises the cost of production, and except in areas distant from the coal fields, it will be difficult for them to compete with pit head stations on remunerative terms.

A substantial part of the cost of production is the heavy assessment for rates on this and other public services, and a reduction of this tax is overdue. With a lower rate charge and cheaper fuel, the domestic heating load will be much increased, and this load has a vast potential magnitude. The lowered cost is also favourable to railway electrification, and the addition of these loads will help to reduce the cost of distribution. The combined effect will bring about a new era of development.

A general scheme of this kind, which unites two industries to their mutual benefit and to the advantage of the public, will require a national board for harmonising all the interests involved, but this is now a recognised method of organisation.

Origin and Use of 'Yerba Maté'

Infusions from vegetable products are common throughout the world; but *yerba maté*, which Capt. T. A. Joyce discusses in his presidential address to Section H (Anthropology), is peculiar to Paraguay and South Brazil; leaves and shoots of a shrub of the *Ilex* family (*Ilex paraguayensis*) are dried by fire, hot water poured on the powder or broken leaf, and, usually throughout the many countries of South America where its use became far-spread from the land of origin, was and is imbibed through a silver or bamboo tube. The drink contains little or no tannin, combines well with a meat diet, taking the place of vegetables and fruit when these are absent, and is a valuable anti-scorbutic.

Its commercial use appears to date from soon after the entry of Jesuits into South America; the first Jesuit mission was established in 1609, the last in 1760; between those dates great establishments of the missionaries spread along the banks of the Paraná River and its affluents, in South Brazil, Paraguay and North-east Argentina. Converts were concentrated in these spots, and the Jesuits, as in other regions, sought a lucrative commerce which should make the mission stations economically independent. The leaf of the ilex provided a means of supplying Spanish colonies in many parts of South America with a drink which formed a substitute for the then often unprocurable wine, and had definitely good medicinal effects. The Jesuits also encouraged the use of the ilex infusion among converts, to replace the fermented drinks to which many races were addicted. When the Jesuits were expelled in 1774, the maté industry was reckoned to yield profits of more than £100,000 annually; the leaf was traded to Buenos Ayres, Uruguay, Chile, Peru, Bolivia and Ecuador; Asunción, on the Paraná, was the greatest depot. Use of the ilex is first mentioned by Nicolás Durán, a missionary writing in the early seventeenth century; among other authorities quoted are Pinelo (1636); del Techo (1649–72); Frézier (1712–14); Juan and Ulloa (1740–1744); J. P. and W. P. Robertson (1811–1830); Demersay (1860); Southey (1817).

The honour of giving a botanical name to the shrub falls to the English botanist A. B. Lambert, who described and illustrated *Ilex paraguayensis* in 1824; the French botanist Bonpland, who went in 1820 to Paraguay, sought it in its native forests, but was imprisoned by the autocrat Francia for many years, and lost the opportunity.

Many attempts were made during Jesuit times to germinate the ilex seed and thus to establish social plantations in convenient regions, to obviate long and arduous journeys to points in the wild

forests neighbouring the Paraná; these were eventually successful, but the secret was lost after the ruin of the missions until recent times, when plantations have been created in the old Misiones Territory, North-east Argentina. It is rather remarkable that the first explorers in the country, Ulrich Schmidt (1535–1553) and Cabeza de Vaca (1541–1544) make no mention of the use of the ilex, though they were for the most part travelling through its natural habitat. No mention of its use occurs until after the establishment of the Jesuit missions.

The study of ethno-botany is of high importance; for this reason the subject of a valuable plant was chosen. A short time only elapses before the origins of such plants—with maize as a notable example—are lost during a rapid spread all over the world; stimulants and narcotics share a similar fate. It is therefore suggested that a great opportunity exists for a trained botanist to re-write the fine work of A. de Candolle, the "Origin of Cultivated Plants", a new and up-to-date edition of which is badly needed.

Normal and Abnormal Colour Vision

Prof. H. E. Roaf, president of Section I (Physiology), takes colour vision as the subject of his address.

The study of colour vision is important because it is concerned with one of the most important sensory processes, and a complete understanding of the problems of colour vision would help to explain all other central processes of sensation. The special problem in the study of colour vision is the nature of the receptor organs in the retina.

Analyses of colour sensations show that it is possible to reproduce all colour sensations on the assumption that there are three types of receptors in the retina which are differentially stimulated by the various wave-lengths of light. The above conclusion is the basis of the trichromatic hypothesis advanced by Thomas Young in 1802.

Sensations of white and of yellow are psychologically homogeneous perceptions which can be reproduced by heterogeneous stimuli. The former can be produced by light from two, three or more regions of the spectrum, whilst the latter can be produced by stimulation with one or two regions. Sensations of black are produced not by absence of stimulation but by relatively less stimulation than that of other areas of the retina.

Defective colour vision is usually congenital, and its peculiarity is that the individuals affected by congenital defect in colour vision fail to distinguish 'red' from 'green' but they can distinguish 'blue' from 'not blue'. The normal person can distinguish 'red', 'yellow' and 'green', whilst those with marked defective colour vision can see only one colour corresponding to the above three. This colour is often said to be yellow, but it is more correct to describe it as 'not blue'; it is called yellow as that is the complementary colour to blue. Even if only two types of receptors are present, there must be differences in the degree to which each is stimulated by light close to the 'blue' of the spectrum and that in the 'red' of the same.

Theories of colour vision have been largely influenced by the view of Helmholtz. He elaborated the trichromatic theory of Young by advancing the view that the differential stimulation was due to three substances which were acted upon to varying degrees by the different regions of the spectrum. This view that there are three photosensitive substances in the retina has no support which excludes other interpretations. Up to the present, only one photosensitive substance has been definitely demonstrated.

An alternative view of Max Schultze is worthy of consideration. He points out that the coloured oil globules in the retinæ of birds would give rise to differential action on one photosensitive substance. Colour filters have not been found in the retinæ of mammals above marsupials, so that this view is equally hypothetical with that of Helmholtz. The main difference is that colour filters are easy to demonstrate in birds, etc., but no one has yet proved the presence of more than one photosensitive substance.

Psychology and Social Problems

In his presidential address to Section J (Psychology), Dr. Shepherd Dawson suggests that the problems that arise from living in a community, such as those of supply and demand, capital and labour, law and order, hygiene, transport, etc., are as much mental as material, and that their solution demands some knowledge of the agencies that move men to action, their inborn tendencies, their acquired habits, and the mentality of the groups to which they belong. Such knowledge, to be of real value, must be based, not on casual observation and intuition, but on the systematic, objective and controlled inquiry that characterises scientific method.

Social problems can be approached from the point of view of either the individual or the community, but neither approach can be consistently maintained to the exclusion of the other, for man is not independent of his fellows; his social environment is part of himself, and he is a unit in the social organism. The big social problem is the dual one of fitting the individual into the group and fitting the group to the individual. This is

essentially an educational problem in the widest sense, one that concerns the home, the school, the Press, etc.

The development and use of objective methods of studying mind are beginning to provide information of social importance, which, though still scanty, is suggestive. Mental tests have been applied more or less carefully, and in forms more or less satisfactory, to children of all ages, races and grades of society, and the results obtained raise some hope of getting reliable information regarding the distribution of intellect in the population as a whole and in the various professional, social, racial and economic strata, and regarding its connexion with fertility, disease, environment, and other conditions: they offer, too, a method of studying the puzzling problems of mental inheritance.

Distinguishing between capacity and ability, Dr. Dawson insists on the need for care in interpreting the results of attempts to measure them. He briefly indicates some of the results of attempts at mental measurement: in particular, the distribution of intellect in the population, as measured by mental tests, throws some light on certain educational and social problems. It is well known that the educational casualties in post-primary schools are enormous: in Scotland about 44 per cent of the children of age twelve embark on a secondary school course; of these 70 per cent begin the second year work, 43 per cent the third, 22 per cent the fourth, 15 per cent the fifth, and 9 per cent the sixth. Of those who pass to 'advanced divisions' only 14 per cent enter the third-year course. The distribution of intelligence in the population, the curricula and examinations of the schools and the fact that it is usually the duller pupils who fall out first, all suggest that these casualties may be due to an attempt to provide for the few who have the intellect and temperament for professional and administrative work, to the neglect of the majority who are of average or nearly average capacity.

Forest Biology

In his presidential address to Section K (Botany), Prof. A. W. Borthwick discusses "Some Aspects of Forest Biology". The present-day endeavour to grow pure forests involves many problems demanding scientific forest management, with the aim of obtaining the highest yield in the shortest time. In this, the inseparable connexion between botany and forestry becomes all-important.

The climatic factor has an important bearing on forestry. The optimum region where the general balance in climatic factors is the most favourable usually produces the most desirable results with a minimum of trouble and cost. The question of acclimatisation is far from settled, though it is of the utmost importance. Reaction to light intensities and edaphic factors, too, form an important study. Though the tree may react temporarily to certain changes in conditioning factors, there is no evidence that such reaction becomes permanent and hereditary.

In forestry, the long period which must elapse between the establishment of a crop and its final harvesting makes it imperative that a judicious choice of trees best adapted to any given locality be made. Here again, the forester comes into close contact with the botanist. The structure of trees, their reaction to conditioning factors, and, above all, their individual variability must all be taken into consideration during afforestation.

The fundamental biological facts of sylviculture may be grouped according to the three stages of the life of a forest; juvenile, pole or stage of most rapid height growth, and adult stage. In the juvenile stage, clearing and weeding must not be delayed. Thinning out, too, is important. The pole stage is the time of greatest density in the life of the stand. Here the skill of the forester is put to the test, for now is the time to encourage length, form and cleanness of stem. In the adult stage, work should be diverted into obtaining the greatest volume production and quality of timber by controlling diameter increment.

The biology of the large pure stands of timber naturally differs from that of mixed stands. The arrangement of the different species in a mixed stand is a difficult problem. It would seem that the suggestion of Prof. Heinrich Mayer that the forest should be made up of small compartments, each compartment consisting of one species, satisfies most of the requirements of the trees.

Other aspects of the forest as a living community which have not received much attention yet are its biological influences, especially on drainage and water supplies; and its effect on winds in breaking and tempering them. This latter involves the question of a reasonable balance between forest and grazing land, which is one of considerable biological and economic importance.

Science at the Universities

In his presidential address to Section L (Educational Science), Mr. H. T. Tizard refers to the financial responsibilities of universities. The high cost to the public of teaching science at universities makes it necessary to consider seriously whether an increase in numbers of science students can be justified.

The problem of numbers of science students can be regarded from various points of view. Most

branches of the chemical industry welcome university graduates as recruits, and do not demand of them a considerable knowledge of the practical problems of industry. Many employers in the engineering industry, however, expect a university graduate of engineering to have a wide acquaintance with practice, and regard him as a misfit if he has not. As a result, there is a constant tendency for university departments of engineering and of the branches of technology to introduce practical instruction of a kind more suited to technical schools. This tendency must be resisted; and one way to resist it is to restrict the numbers of students. The chief aim of university departments of technology should be to produce the leaders of the technical professions. They must avoid the temptations of mass production. Unfortunately, however, the immediate effect of restricting numbers is to make the financial difficulties of universities greater, for the fee income is reduced, and expenditure cannot be reduced so quickly.

The opportunities for suitable employment open to students of some branches of applied science are limited. Two years ago, a strong Government committee reported that the supply of industrial biologists was not equal to the demand, and attributed the reason for this largely to the neglect of biology as a subject of study in schools. If universities had taken this report seriously, a large number of highly-trained specialists would now be looking vainly for employment. University authorities must form their own judgment about the probable demand for specialists three or four years hence, and must organise their 'schools' accordingly. It is a better policy in the long run to keep the supply of highly-trained specialists short, rather than in excess, of demand.

The neglect of biology at schools is not responsible for an alleged shortage of biologists; it has certainly not led to a shortage of doctors. The next generation may see a development of the biological sciences comparable with that of the physical sciences, and their applications, in the last thirty years; but the time is not yet ripe.

The complaint that the general education of a university student of science is defective, and that there is too early specialisation at schools, is also discussed. Mr. Tizard sympathises with the difficulties of schoolmasters, who often have their hands forced by the standard of scholarships set by universities. The Imperial College proposes to award scholarships on a general examination for an experimental period of five years. If university authorities really believe that the standard of general education is too low, the remedy is largely in their own hands. They must revise the matriculation examination, and make it appropriate for the normal age of entry. At the same time, they must not demand so much specialised knowledge from scholarship candidates.

In conclusion, it is argued that universities should now attempt to provide for students who wish to study science as a cultural subject. University education in science and technology is at present primarily designed to produce specialists. There is an urgent need for skilled administrators and men in public life who have a real knowledge of the principles of science. No university is making a serious attempt to meet this need.

Scientific Planning of Rural Life

The subject of Prof. J. A. S. Watson's presidential address to Section M (Agriculture) is "Scientific Progress and Economic Planning in Relation to Agriculture and Rural Life". Ever since the beginning of civilisation, the rate of improvement in agricultural technique has controlled and conditioned, to a considerable degree, the progress of the human race. This progress has been of two kinds—on one hand an increase in numbers and on the other a rise in the material standard of life.

At certain times and places, improvements in farming have failed to keep pace with the potential rate of growth of population, and population has been kept down by the periodic recurrence of famine. The idea that scarcity is a normal occurrence continues, indeed, to colour a great deal of our thought. But in the more advanced countries, during the past fifty or sixty years, the productive capacity of the agriculturist has been rising at an unprecedented rate, which is tending to become ever more rapid. Meanwhile, in these countries as a whole, the rate of increase of population has been slowing down. There is now no doubt that the demand for agricultural produce can be met, in the future, by a diminishing number of agriculturists. The available reserves of land and of other raw materials are so large that there can be no ground for anxiety for many generations to come.

The present crisis in world agriculture has largely arisen out of our failure to realise these broad facts. Land settlement in the new countries has been actively encouraged, while none of the old countries has been prepared to reconcile itself to a less intensive use of its soil. States have, almost without exception, tried to check the natural flow of population out of farming and have even, from time to time, adopted measures designed to drive people back to the land. The result has been that the farmer, while finding it ever easier to produce, has found it ever more difficult to sell. For more than a generation,

the farmers of the world have been progressively impoverished and burdened with debts, so that they were in no condition to face a period of financial disorganisation bringing an abrupt fall in the general price level.

During the past few years, there has been a growing realisation that the farmer's economic lot was becoming unendurable, and a variety of expedients have been adopted in the endeavour to ensure something like fair prices for agricultural commodities—compulsory restriction of output; monetary compensation by the State for restrictions voluntarily made; even plans for the destruction of produce judged to be surplus; State subsidies designed to make good the difference between cost of production and market price; export subsidies; tariffs and many more.

The most logical of these schemes are based upon the essentially simple idea that the efficient producer shall be promised, in advance, a reasonable price for a given quantity of produce, and that a system of contract production shall replace that of competitive selling. The translation of this idea into practice is an immense task, but remarkable progress has already been made. There is every hope that economic planning will prove the way that we seek, the way of realising, in terms of human good, the potential benefits arising out of our growing command over Nature.

Scientific Societies and Museums

The ever-increasing share which scientific knowledge and method are taking in both the social life and the industrial activity of the community makes ready access to all kinds of information of primary importance; and in facilitating this, the scientific society, the public library and the museum already play an important part. It seems, however, that by closer co-operation, the services that they can render in this direction can be materially increased. This topic forms the theme of Sir Henry Lyons' presidential address to the Conference of Delegates of Corresponding Societies attending the Aberdeen meeting of the British Association.

At the present day many firms in technical industry are employing to an increasing extent scientifically trained men in their research departments, and to them a ready access to current scientific and technical literature is all-important, not only for study but also to follow up a reference, or to scan in order to see in what direction knowledge in their branch of scientific inquiry is moving.

At the present time, through the facilities afforded by the National Central Library and the Science Library of the Science Museum, London, research workers have ready access to as wide a selection of current scientific and technical periodical literature as any country can offer, but it seems to be comparatively little known and is therefore not nearly so fully utilised as it might be.

Discussion in scientific and technical subjects, which is readily obtainable in London and in the larger cities, may be less easy to arrange elsewhere; and yet such discussion may bring to light methods and equipment already in use in one field of investigation which can be advantageously introduced in others. The International Council of Science Unions at its recent meeting has appointed a committee to promote such co-operation in the international field, at the suggestion of Dr. G. E. Hale, of Mount Wilson Observatory, California, who, in the designing of the new 200-inch telescope and its equipment, has found in other branches of science examples which have been of the greatest value to him and his colleagues. There is no reason why co-operation in more restricted fields should not be equally profitable, and for its promotion local scientific societies are specially well adapted.

Closely related to the provision of information by ready access to published material and by discussion of technical and scientific problems confronting scientific workers in any district, there is the influence which the museum may exercise in similar fields. Such institutions can scarcely aid the scientific worker by bringing to his notice the newest advances in his subject, but now that so many of them are giving attention to the representation of the technical industries which have been established in their vicinity, well-designed and critically selected exhibits of them and their newest advances can be most suggestive and of real value to those whose main interests lie in other fields. Many of these institutions have in the past received their main support and encouragement from those who were interested in archæology and natural history, but science and technology are now finding more ample provision so far as space admits. The establishment of the Municipal Museum of Science and Industry at Newcastle-upon-Tyne a month or two ago is a good example of what can be done in this field; and there, too, is the North East Coast Institution of Engineers and Shipbuilders, a scientific society of high standing and repute, to assist and guide the new Museum in its development.

There is without doubt a wide field of co-operative effort which can be developed with the purpose of facilitating access to the technical and scientific information which exists in Great Britain, but which is not as much utilised as it might be; in this task the society, the library and the museum have their parts to play.

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in amounts which can supply local markets; others would supply a limited overseas demand; and still others are capable of supplying a large export market." The species treated of in the pamphlet of the so-called 'Ash Group' are *Eucalyptus regnans, gigantea, obliqua, sieberiana, fastigiata, oreades, fraxinoides* and *consideniana*.

British Breed Standards of Domestic Animals

A BREED standard, well-defined though it may be at the moment, is a fluctuating measure of quality, and Herbert Haseltine has done good work for science as well as for art in creating the sculptures of typical British champions of domestic breeds at the present day. The series of statuettes, nineteen in number, cast in bronze or carved in stones of various hues and textures, chosen to suggest the colours and characteristics of the animals, was exhibited in London and Paris in 1925, and now, thanks to the generosity of Marshall Field, has taken its place as a permanent exhibit in the Field Museum of Natural History in Chicago. A pamphlet (Zoology Leaflet, 13) has just been issued by the Museum, illustrating and describing briefly the models in this unique series, which is a permanent tribute to the skill of the stock-breeders of Great Britain.

Drought and Disease in Lambs

As a result of the prolonged drought of last year, a bad outbreak of 'stomach-worm disease' or 'scouring' developed in lambs during the late part of autumn and early winter, causing heavy losses to sheep in many parts of Great Britain. There can be little doubt that the outbreak was due to deficiency in food, owing to the shortage of grass, for such a condition has been found to lead to a great increase in the numbers of parasitic worms. To prevent severe infestation it is necessary to keep up the condition of the lambs. The weather conditions of the present year in many ways resemble those of last year, and there is danger of a recurrence of stomach-worm disease with its attendant losses. Farmers and others interested are therefore recommended to apply for the account of the life-history of the parasitic worms, with information about their distribution and control, published as Leaflet 75 by the Ministry of Agriculture and Fisheries and issued free of charge.

Oil in Western Canada

THE fact that the second edition of "Oil and Gas in Western Canada" by G. S. Hume (*Canada, Dept. Mines, Econ. Geol.*, Ser. 5, 1933) contains twice as many pages as the first is an indication of the mass of new data of oil and gas prospects in western Canada acquired during the last five years. The author has wisely refrained from amplifying to any marked extent the brief introductory chapter on oil origin and accumulation, but the additional illustrations of various types of structures certainly make his digest more palatable both to the uninitiated and to those familiar with the subject. In view of the rapid advancement of geophysical science and its now widespread application, the chapter on this subject is still too brief and sketchy to be of real technical value. In the first edition, a chapter was devoted to a survey of carbon ratios in relation to known occurrences of oil and gas, emphasis being laid on the fact that favourable structures can be determined by means of these ratios; it is therefore significant that this section has been omitted in the second edition. The additional information given is wholly relevant to the main issue, and serves as a useful basis of comprehension of the actual descriptions of oil and gas fields. Order and proportion are given to these descriptions, and valuable technical data contained therein made more accessible by division of the region under review into seven districts, namely, the Foothills, Southern, Central, and Northern Plains of Alberta, the Plains of Manitoba and Saskatchewan, Northwest Territories, and British Columbia. Lack of an index, however, to such a large volume is a decided disadvantage.

Safety in Mines Research Board

THE Safety in Mines Research Board has just issued its twelfth annual report; this report is always looked forward to with a good deal of interest by all connected with coal mining in Great Britain, and this twelfth report is especially interesting because it includes a report on matters that come under the purview of the Health Advisory Committee. The subjects dealt with are exceedingly wide, but all have bearing on the safety of men engaged in any way in coal mining. A number of the detailed reports, which are contained in appendixes to the main report, have already been published, chiefly in the *Transactions of the Institution of Mining Engineers*, and these are exceedingly important. It is also of the greatest interest to find that this Board is co-operating with similar bodies in other countries, and especially with the United States Bureau of Mines, with the French, German, Belgian and other interested bodies.

French Mathematical Tracts

FOR the last six years the well-known Paris publishers Hermann et Cie. have been issuing brief but authoritative accounts of recent research work in many fields under the general title of "Actualités scientifiques et industrielles". Several of the latest additions to this series are of a mathematical nature, and are grouped under various sub-headings such as "Exposés d'Analyse Générale" (which deal with developments of Cantor's theory of aggregates), "Exposés de Géométrie", and "Exposés mathématiques". One of the tracts placed in the third group might very well have been included in the first. The authors include M. Fréchet, Emmy Noether (who writes in German), A. Appert, M. Brelot, J. Dieudonné, L. Godeaux and N. Lusin. Some of these confine themselves to rather special problems investigated by themselves, while others, notably MM. Fréchet and Appert in their "Exposés d'Analyse Générale", give a general account of all the results obtained in the field considered. The number of pages in a tract varies from 11 to 63, and the price from 5 to 14 francs. The style has the clarity and charm which are characteristic of French exposition.

Designs upon Postage Stamps

SLIGHT changes in colour and design have just been made in certain postage stamps for Great Britain, printed for the first time by lithographic process; now the United States of America has notified the appearance of new issues. These are to bear striking scenes from ten of America's National Park areas, such as Yosemite's El Capitan on the one cent stamp, the Grand Canyon on the two cent, Old Faithful Geyser on the five cent, Crater Lake on the seven cent, and, an interesting breakaway from tradition, a prehistoric apartment from the great Mesa Verde 'cliff palace' on the four cent. There is a great deal to be said for the reproduction of features which give a new beauty and interest to each stamp, and at the same time spread a knowledge of the great natural monuments of the country open to traveller and naturalist.

Dissemination of the Brazil Nut

IN his article on the germination of seeds with stony endocarps, printed in NATURE of June 16, Sir Arthur Hill referred to the difficulties of germination in the Brazil nut. Mr. C. Jinarajadasa writes from Belém, Para, that he mentioned this to Dr. Carlos Estevão, director of the Goeldi Museum, Para, Brazil, who stated that two varieties of agouti (*Dasyprocta fulginosa*, Wagl., and *Aguti-Aguti*, L.) are able to break up the hard shell of the Brazil nut with their sharp teeth. After eating a few nuts they bury the remainder in various places, and in this manner Brazil nut seeds are spread and germinate without interference with one another.

New Analytical Balance

WE have had an opportunity of examining the "New Empire" Analytical Balance made by Messrs. Baird and Tatlock (London) Ltd., 14–17 Cross Street, Hatton Gardens, London, E.C.1, and find that it has a number of interesting features. The fittings which are usually of brass are made in stainless steel and other parts are chromium plated. The beam is finished black, which is claimed to be fume and scratch proof, and the top edge is bevelled so that the rider can be accurately placed. The rider scale is white on black, and is easily read. The side and front doors are large and open easily, and the pan hangers are widely spaced so that large flasks may be weighed. Loose bakelite pans are supplied to fit over the metal pans and we found that these were adjusted in weight within two milligrams. The lifting mechanism worked very smoothly, and the period was reasonably short. The sensibility was very good both with small and heavy loads, and the balance is suitable for all accurate work requiring four places of decimals of a gram. The finish of the whole balance is very good, and its appearance compares favourably with that of much more expensive instruments. The agate knife edges and planes are sensibly mounted, and the robust character of the balance makes it very suitable for use by students. The boxes of weights supplied for use with the balance are of gold-plated pieces with fractions in nickel and aluminium, the whole being enclosed in a bakelite block and case which will not warp, the top of the block being covered with velvet. We formed a very favourable opinion of the balance and weights, which represent exceptionally good value for the price charged, and should make a wide appeal to various types of users.

Announcements

PROF. JACOB G. LIPMAN, dean of agriculture in Rutgers University and director of the New Jersey Agricultural Experiment Station, has been awarded the Chandler Medal of Columbia University for 1934, for his work in agricultural chemistry. The Chandler Medal is awarded annually by Columbia University for "conspicuous work in the field of chemistry". Prof. Lipman was president of the First International Congress of Soil Science and is the founder and editor of *Soil Science*.

THE Third International Locust Conference will meet in London on September 11 in the Lord Chairman of Committees' Room, House of Lords, under the presidency of Sir John Chancellor. His Majesty's Government in the United Kingdom will be represented by Sir Guy A. K. Marshall, director of the Imperial Institute of Entomology; Mr. B. P. Uvarov, senior assistant, Imperial Institute of Entomology; Mr. H. B. Johnston, chief locust investigator of the Institute; Mr. G. F. Seel of the Colonial Office; and Mr. M. C. Mossop, nominated by the Government of Southern Rhodesia. The meetings will be open to the public. Cards of admission may be obtained from Mr. Francis Hemming, Secretary-General to the Conference, 2, Whitehall Gardens, S.W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A technical officer at the Admiralty Technical Pool—The Secretary of the Admiralty (C.E. Branch), Whitehall, London, S.W.1 (Sept. 12). An assistant agricultural organiser to the Nottinghamshire Education Committee—The Director of Education, Shire Hall, Nottingham (Sept. 12). An assistant at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1 (Sept. 15). A chemist in the Department of the Government Chemist—The Government Chemist, Clement's Inn Passage, Strand, W.C.2 (Sept. 15). Assistant civil engineers in the Civil Engineer-in-Chief's Department, Admiralty and H.M. Naval Establishments—The Civil Engineer-in-Chief, Admiralty, London, S.W.1 (Sept. 15). An assistant plant pathologist in the Department of Agriculture and Lands, Salisbury, Southern Rhodesia—The Official Secretary, Office of the High Commissioner for Southern Rhodesia, Crown House, Aldwych, London, W.C.2 (Sept. 15). A superintendent of forests in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W.1 (Sept. 20).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Radioactivity of Potassium

SOME time ago one of us attacked the problem of the radioactivity of potassium by carrying out a partial separation of its isotopes and determining the atomic weight and the radioactivity of the 'heavy' fraction obtained. The fact that the 'heavy' fraction was found to be more active than the normal potassium proved that the activity is not due to the main isotope 39 but to a heavier one. By comparing on one hand the activities of these two samples and their atomic weights on the other, it is possible to determine the mass of the radioactive isotope.

While the comparison of the radioactivity[1] could be carried out with the necessary accuracy, the comparison of the atomic weights with sufficient accuracy involves some difficulties. Hönigschmid, some years ago, and Sachtleben recently in his laboratory, found for the difference between the atomic weight of the normal and of our 'heavy' potassium exactly the same value, and their figure is only compatible with the assumption that the activity of potassium is due to an isotope of mass 41 or possibly 42, while Baxter's determination leads to a lower value (40). Another line of attack is to search for the disintegration product of potassium. The emission of a β-particle changes the atom of potassium into an isotope of calcium. We therefore extracted the calcium from very old Norwegian biotite rich in potassium (6 per cent) but containing only about 0·05 per cent calcium, kindly given us by Prof. V. M. Goldschmidt. All chemicals used were most carefully purified from calcium to avoid contamination of the calcium present in the biotite. The investigation by Aston[2] of the sample obtained did not, however, reveal any difference from common calcium.

Some time ago we investigated in a magnetic field the radiation emitted by potassium to search for the possible presence of positrons. The search led to a negative result. At the same time we studied the effect of the variation of the magnetic field on the number of β-particles registered by the point counter. In view of the small intensity of the potassium radiation, the investigation of the magnetic spectrum involves great difficulties; however, the accuracy is sufficient clearly to indicate the presence of two strong components, having the energy of about 3×10^5 and 7×10^5 e.v., the former having the greater intensity. It is of interest to note that measurements carried out by an entirely different method by Bocciarelli[3] led to a similar result.

If we assume that these two components are due to β-particles originating in the nucleus of the same potassium atom, the transformation of the latter must lead to the formation of an isotope of scandium, a conclusion which can be tested. In searching for a calcium isotope of short life as a result of the emission of the first β-particle, we precipitated calcium oxalate from a solution of potassium chloride and tested with a Geiger counter the activity of the precipitate within 30 seconds, reckoned from the beginning of the chemical operation. The result was, however, a negative one. The failure of Aston to detect a calcium isotope produced by the decay of potassium is possibly due to the fact that the decay leads to the formation of a calcium isotope having a very short life, and a stable scandium isotope.

Another possible explanation was put forward by Gamow[4]. He assumes that potassium emits α-rays not yet detected, and that the β-radiation observed is due to a chlorine isotope produced by the decaying potassium nucleus. Gamow calculates the ranges of the hypothetical α-radiation of potassium and of rubidium to be 0·24 cm. and 0·63 cm. respectively. By using Geiger's multiplication method we were unable to find any indication of the presence of α-particles in the radiation emitted by potassium or rubidium. We then tried to obtain α-tracks from rubidium by cloud chamber photographs. 1,400 exposures were taken at a pressure of 23 cm., the surface—covered by a rubidium compound—being 55 cm.[2]. Not a single track could be observed, though experiments carried out with α-radiation cut down to a small residual range have shown that particles having a range as short as 0·1 cm. could still be detected. A negative result was also obtained when investigating with the point counter precipitates of silver bromide, obtained from solutions containing potassium and rubidium nitrate, within 20 sec. reckoned from the start of the chemical operation.

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[1] G. v. Hevesy, W. Seith and M. Pahl, *Z. phys. Chem.*, Bodensteinfestbd., p. 309, 1931.
[2] F. W. Aston, NATURE, 133, 869, June 9, 1934.
[3] D. Bocciarelli, *Atti. R. Accad. Lincei*, (6), 17, 830; 1933.
[4] G. Gamow, NATURE, 133, 744, May 19, 1934.

Catalytic Interchange of Hydrogen between Water and Ethylene and between Water and Benzene

IT is known that, in the presence of a platinum catalyst, there is an interchange of hydrogen atoms between gaseous hydrogen and water[1]. Recent observations have proved that nickel can also act as a catalyst of this reaction. On the other hand, A. Farkas, L. Farkas and E. K. Rideal[2] have shown that the hydrogenation of ethylene on a nickel catalyst is preceded by an interchange between the hydrogen atoms of the ethylene and the hydrogen used for hydrogenation. Afterwards it was found by the authors in collaboration with G. Ogden[3] that a metallic catalyst causes a rapid exchange of hydrogen atoms between benzene and gaseous hydrogen at ordinary temperatures, while at the same time hydrogenation is very slow.

We have now found that these two sets of experiments can be combined into a new process: a metallic catalyst is capable of bringing about an exchange of hydrogen between ethylene and water, and also between benzene and water.

A series of experiments for ethylene and water were carried out as follows. About 35 c.c. at N.T.P. of ethylene was enclosed with 100 mgm. water containing 3 atomic per cent of heavy hydrogen, in a sealed tube of 140 c.c. capacity, and after adding 1·5 gm. of a nickel catalyst the mixture was kept at 80° C. After 7 hours, the hydrogen of the ethylene

was found to contain 0·6 per cent of D. Tests made after 24 and 48 hours showed a constant 1·3 per cent of heavy hydrogen in the hydrogen of the ethylene. Assuming that at this value equilibrium was attained, we obtain for the distribution coefficient of heavy hydrogen between water and ethylene (that is, per cent heavy hydrogen in the hydrogen of the water phase compared with per cent heavy hydrogen in the hydrogen of the ethylene phase) a value of 1 : 0·58 = 1·7.

The interchange of hydrogen between benzene and water was obtained in a similar way: 0·16 gm. of benzene was heated with 0·135 gm. of water containing 3 per cent of heavy water in a sealed tube of 50 c.c. capacity, in presence of 1·45 gm. of the nickel catalyst. After 2 hours, the heavy hydrogen content of the hydrogen in the benzene was 1·5 per cent and the same value was found after 6 and 12 hours. These data give for the partition coefficient of heavy hydrogen between water and benzene (at 200°) a value of 1·05.

The above processes seem to provide a convenient method for the replacement of H by D in organic compounds containing double bonds or aromatic rings.

J. HORIUTI.
M. POLANYI.

University,
Manchester.
Aug. 20.

[1] J. Horiuti and M. Polanyi, NATURE, 132, 819, 931; 1933. *Manch. Lit. Phil. Soc.*, 78, 47; 1934.
[2] *Chem. and Ind.*, 53, 489; 1934. E. K. Rideal, *Chem. and Ind.*, 53, 610; 1934.
[3] *Trans. Far. Soc.*, 30, 663; 1934.

Interferometer Patterns of the Hydrogen Isotopes

IT has been suggested to me that the accompanying photographs (Fig. 1) showing the Fabry-Perot patterns of the red Balmer line for ordinary hydrogen and for a mixture containing an appreciable amount of the heavier isotope, might be of interest to readers of NATURE. They were taken by Dr. E. Gwynne Jones with the arrangement used by him and by Dr. S. Tolansky for their fine-structure researches, in order to estimate the percentage of heavy hydrogen in this mixture, which was being used by Dr. R. W. B. Pearse and me for other purposes. Originally the gas was supplied to Prof. F. Paneth by Dr. P. Harteck.

The tube used as a source of light was excited by a high-frequency discharge, with external electrodes, and exposures were made at or above room temperature. With an étalon gap of 3 mm. the fringes for

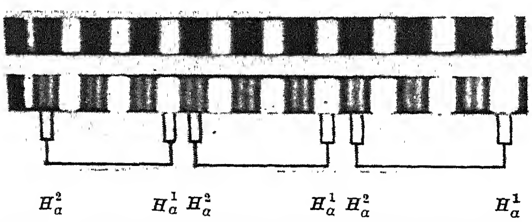

FIG. 1. Fabry-Perot fringes of H_α. Ordinary hydrogen (top); mixture containing 10–15 per cent of the heavy isotope (bottom).

the heavier isotope (which show the doublet structure of H^2_α so clearly) were separated from those of the lighter by some 2½ orders as indicated in Fig. 1.

I have recently shown that this method affords a ready means of estimating quantitatively the relative amounts of the two isotopes in a mixture. In Fig. 2, fringes are shown for three different tubes prepared by Prof. Paneth. The way in which the concentration

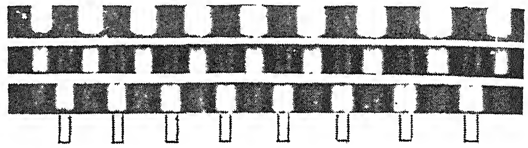

FIG. 2. Patterns for mixtures containing 10 per cent (top), 33 per cent (middle), and 75–80 per cent (bottom) of heavy hydrogen. The position of the heavy isotope doublet is marked.

of diplogen is increased from 10 to more than 75 per cent by continued electrolysis of water is well shown in the photographs.

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Anomaly in the Specific Heat of Ferrous Chloride at the Curie Point

THE susceptibility of ferro-magnetic metals above the Curie point depends on temperature according to the law $\chi\ (T - \theta) = C$. A similar relation holds for the anhydrous salts $FeCl_2$, $CoCl_2$, $CrCl_3$ and $NiCl_2$, θ varying from 20° to 67° K. It appears natural to assume that at temperatures below θ, these bodies become ferro-magnetic.

Measurements made at Leyden[1] show that at temperatures below θ the magnetic susceptibility of all these bodies depends on the field-strength; it can, however, by no means be said that they become ferromagnetic in the ordinary sense.

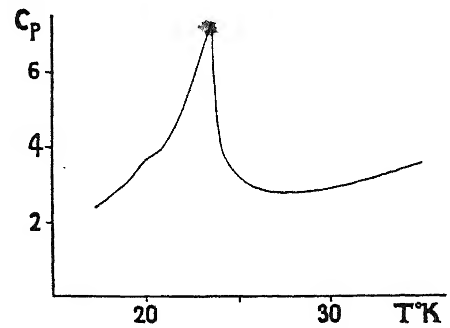

FIG. 1.

In order to clear up the nature of this anomaly we have measured the specific heat as a function of temperature, since this relation should show whether the anomaly is connected with the appearance of a molecular field or not. This is all the more interesting, inasmuch as Landau's[2] theory would lead us to expect peculiar ferromagnetic phenomena in some of these salts. The first body to be investigated was $FeCl_2$, the specific heat of which (C_p for 1 gm.-mol.) is plotted as a function of temperature on Fig. 1. The experiments show a large jump in the specific heat at 23·5° K., the shape of the anomaly being similar to that found in ferromagnetic metals. Hence we conclude that the anomaly in the specific heat, and also that in the susceptibility, of $FeCl_2$ is

connected with the appearance of a molecular field at a well-defined temperature, which, in analogy to ferromagnetic bodies, we shall call the Curie point.

It is characteristic that, in accordance with Landau's theory, the Curie point 23·5° is higher than the value of $\theta = 20 \cdot 4°$ found by Woltjer and Wiersma by extrapolating the law of Curie-Weiss.

The specific heat curve below the Curie point is not completely smooth; a hump is clearly discernible. We are at present not in a position to decide whether this hump is due to the properties of ferrous chloride or to some secondary fact, such as impurities or the presence of helium adsorbed on the powder in the calorimeter.

It is interesting to note that preliminary measurements of the specific heats of $NiCl_2$ between 20° and 80° K. ($\theta = 67°$) do not point to the existence of any marked anomaly. At present we are engaged in measuring the specific heat of $CrCl_3$, in which the results obtained with $FeCl_2$ would lead us to expect an anomalous behaviour.

O. N. TRAPEZNIKOWA.
L. W. SHUBNIKOW.
Ukrainian Physico-Technical Institute,
Kharkov. July 6.

[1] Woltjer, *Leiden Comm.*, 173b. Woltjer and Wiersma, *Leiden Comm.*, 201a.
[2] L. Landau, *Sov. Phys.*, 4, 675; 1933.

Ionospheric Investigations

IN a recent letter[1], Mr. R. Naismith gave a brief description of equipment used for ionospheric investigations by the Radio Research Board as a part of the Polar Year programme. The equipment described made it possible to record the relation between the radio frequency of the pulse signals used and the virtual height reached by them in the ionosphere. Records of this type give a measure of the maximum density of ionisation.

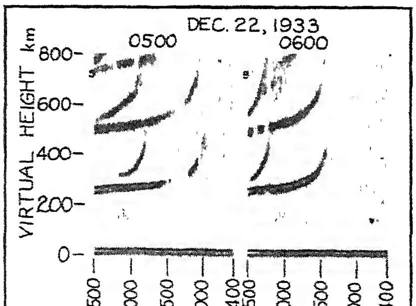

FIG. 1.

Similar equipment was developed at the U.S. National Bureau of Standards[2,3] in 1932, and records extending from April 1933 to date are at hand. Of particular interest are the records obtained at night showing the critical penetration frequencies for the ordinary and extraordinary rays in the *F* region. Fig. 1 shows records obtained at 0500 and 0600 E.S.T. on December 22, 1933. Each record gives the virtual height for the band 2500–4400 kc./s. The frequency is changed at a uniform rate of 200 kc./s. per minute, thus requiring $9\frac{1}{2}$ minutes to pass through the band. Although accurate determination of the actual separation between critical frequencies will await a more nearly simultaneous determination of the two values, the separation is very nearly 800 kc./s. when the ordinary ray critical frequency is at 2500 kc./s.

The greater portion of the critical frequencies obtained at night in this band were for the extraordinary ray. The diagram in Fig. 2 has been plotted from monthly averages of this critical frequency and represents about 1,900 hourly determinations of the

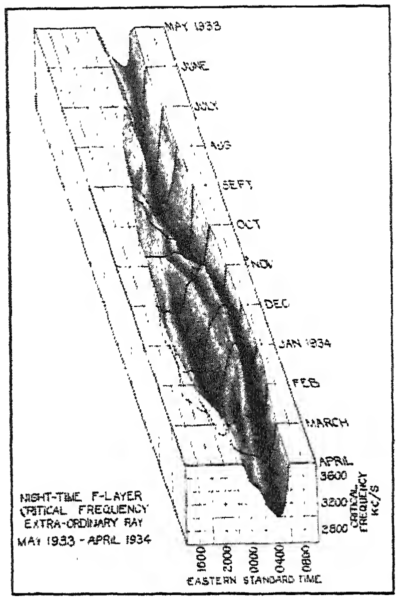

FIG. 2.

type shown in Fig. 1. Calculations from these curves indicate that the two minima in December occurring at 2200 and 0600 represent respectively ionisation densities approximately 1·14 and 2·05 times as great as the minimum value at 0400 in June. The maximum in December at 0430 represents a density 2·65 times as great as the June minimum. The maxima in November and January are slightly higher than that in December.

Work is in progress on the replacement of the preliminary equipment by permanent equipment which will record over a frequency range from 500 to about 12,000 kc./s. The apparatus is arranged to cover this range in four bands. In order to maintain the receiving set accurately in tune with the transmitter, the latter is provided with two oscillators, one variable and the other fixed. The fixed oscillator is set at a value equal to the intermediate frequency of the superheterodyne receiving set. The output from the antenna is either the sum or the difference frequency depending on which band is being used. The variable oscillator of the transmitter serves also as the oscillator for the receiving set. Thus only the detector of the receiving set is required to be tuned, and this tuning is not critical.

T. R. GILLILAND.
Department of Commerce,
Bureau of Standards,
Washington.
June 12.

[1] R. Naismith, NATURE, **133**, 66, Jan. 13, 1934.
[2] Gilliland, *Bureau of Standards Journal of Research*, **11**, 561–566, Oct. 1933. *Proc. I.R.E.*, **22**, No. 2, 236, Feb. 1934.
[3] NATURE, **133**, 57, Jan. 13, 1934.

Ultra-Violet Solar Spectrum and Ozone in the Stratosphere

On June 26, July 7 and 31, we succeeded in sending up registering balloons into the stratosphere, to heights of 21, 20 and 31 km. respectively, with an automatic quartz spectrograph. The plate registering the spectra was moved every few minutes; simultaneously, two barographs and a thermograph recorded pressure and temperature on the photographic plate. In order to avoid the permanent position of the spectrograph direct towards the sun, a plate of magnesium oxide (MgO) was fixed about 1·5 metres below the spectrograph and the latter was directed downwards to the MgO plate.

According to our present calculations, we find that at the first ascent, at a height of 21 km., approximately 40 per cent of the whole layer of ozone was below the apparatus. At the third ascent, at a height of 31 km., we calculate that 70 per cent of the ozone layer was below the apparatus. These results are remarkable because they confirm the new calculations of F. W. P. Götz, A. R. Meetham and G. M. B. Dobson[1], who deduce from the observations of the zenith sky light a height of the ozone layer which is considerably lower than previously supposed.

A more detailed report of the investigations will be published shortly in the *Physikalische Zeitschrift*.

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[1] Götz, Meetham and Dobson. NATURE, 133, 281, Aug. 19, 1933. *Proc. Roy. Soc.*, A, 145, 416; 1934.

Nuclear Magnetic Moments and the Properties of the Neutron

In a recent letter to NATURE, S. Tolansky[1] has discussed the "negative nuclear spins" of nuclei containing an odd number N of neutrons and an even number Z of protons. Nuclei of this group may have both positive and negative magnetic moments (that is, Landé's g-factor of these nuclei may be both positive and negative), whereas if N is even and Z odd, the magnetic moment is always positive.

Without entering into criticism of theoretical considerations raised by Dr. Tolansky (I can agree with Dr. Tolansky in the view that there may exist in Nature two kinds of neutrons—but scarcely of the structure proposed by him—but not in his further inferences), I should like to point out that his statement that "Tamm and Altschuler . . . have attempted to explain the difficulty of negative spins by assuming that several neutrons [as opposed to a single neutron] can contribute to the spin properties" is not altogether correct. In the note cited by Tolansky[2], Mr. Altschuler and I have shown that from the simple fact that the *orbital* motion of the neutron does not contribute to its magnetic moment, and from the generalised Landé formula for the g-factor, it follows immediately that the sign of the g-factor of a neutron, supposed to be moving in a spherically symmetrical field of the rest of the nucleus, depends on the state of the neutron, positive and negative signs being about equally frequent.

This result is independent of any assumption as to the relative direction of the magnetic moment and of the spin of a free neutron, and also holds when several neutrons contribute to the angular and the magnetic moments of the nucleus, as well as when a single neutron is concerned. Thus the facts considered by Dr. Tolansky may be easily explained without special assumptions. In fact, we made the assumption mentioned by Tolansky not to explain the 'negative spins', but only in order to obtain a consistent explanation of *numerical* values of the measured g-factors.

IG. TAMM.

Teberda,
Caucasus.
July 24.

[1] NATURE, 134, 26, July 7, 1934.
[2] *C.R. Acad. Sci. U.R.S.S.*, 1, 455; 1934.

Solubility of Gluten

The tenacious mass obtained when the starch is washed from a dough of wheat flour is termed 'gluten', and is commonly held to contain two distinct proteins, glutenin and gliadin. Glutenin is defined in current textbooks as insoluble in all neutral solvents, but soluble in dilute acid and alkali. Gliadin is also defined as insoluble in neutral solvents, but is distinguishable from glutenin by its solubility in 60–80 per cent alcohol.

It has already been shown by Cook and Alsberg[1] that gluten can be dispersed completely in 30 per cent urea solution, while only partial dispersion is obtained in concentrated solutions of the lyotropic salts, potassium iodide and potassium thiocyanate. Later studies[2] of gluten dispersions in 30 per cent urea led to the conclusion that, although fractions resembling glutenin and gliadin could be obtained from such dispersions, there was no clear-cut distinction between the solubilities of these two proteins. Whole gluten was therefore used in subsequent investigations.

Sodium salicylate. Grams per 100 c.c. solution.	Gluten nitrogen extracted as percentage total gluten nitrogen.	Urea. Grams per 100 c.c. solution.	Gluten nitrogen extracted as percentage total gluten nitrogen.
7·0	92·0	18·0	85·4
8·0	99·2	21·0	94·6
9·0	99·3	24·0	99·7
10·0	99·1	27·0	99·5
12·0	99·9		

Recently we have found that 10 and 12 per cent solutions of sodium salicylate would disperse gluten completely and more rapidly than solutions of the same substances at higher concentrations. Both urea and sodium salicylate are known to exert a denaturing action on albumins, and presumably the rate of denaturation increases with the concentration of reagent. This probably accounts for the lower rate of dispersion of gluten observed in sodium salicylate solutions of high concentration. An attempt was then made to determine more accurately the minimum concentration of urea and sodium salicylate required to disperse gluten. For this determination a tough, tenacious gluten obtained from a high-quality Canadian-grown wheat was employed, since concentrations capable of dispersing such material should disperse less tenacious glutens quite readily. The

method consisted of shaking the gluten obtained from 5 gm. of flour with 100 c.c. of various concentrations of the two solvents for six hours at room temperature, filtering and analysing both the filtrate and solid for protein. The results given in the accompanying table show that 8 per cent sodium salicylate and 24 per cent urea are the minimum concentrations that will cause complete dispersion. Increasing the amount of solvent, or the time of extraction, had little effect on the amount dispersed.

The lower concentration of sodium salicylate required for dispersion, together with the fact that it does not contain nitrogen, favours this reagent over urea as a neutral solvent for gluten. The use of these neutral solvents for dispersing gluten is subject to criticism since they are known to denature other proteins, but it will be shown in papers to be published shortly in the *Canadian Journal of Research* that these reagents have a less drastic action on gluten than the classical solvents, dilute acid and alkali.

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[1] Cook and Alsberg, *Can. J. Res.*, **5**, 355; 1931.
[2] Cook, *Can. J. Res.*, **5**, 389; 1931.

Shape of the Dibenzyl Molecule

SOME time ago, I completed an X-ray analysis of the crystal structure of dibenzyl[1], and showed that the results could best be explained by a three-dimensional model of the molecule, in which the planes of the benzene rings were at right angles to the plane containing the zig-zag of the connecting CH_2 groups, as shown in Fig. 1. The structure is thus an interesting contrast to those aromatic compounds like naphthalene and durene in which all the carbon atoms of the molecule are found to lie in one plane.

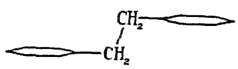

FIG. 1.

More recently, however, Dhar[2] has published the results of an independent investigation of dibenzyl, and his conclusions differ materially from mine. He assigns to the molecule the form shown in Fig. 2,

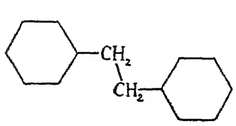

FIG. 2.

with the modification that one benzene ring and its contiguous CH_2 group are depressed below the plane of the paper by 0·12 A. while the remainder is raised above the mean plane by a similar amount. His structure is thus only slightly distorted from the planar form.

To determine the exact shape of the molecule is obviously a matter of some difficulty, because the orientation with respect to the crystal axes is rather complicated. It is quite possible to place each of the above models in a position which makes the projections of the two structures in at least one direction very similar. The matter can only be settled by an exhaustive study of the reflections from several different zones in the crystal.

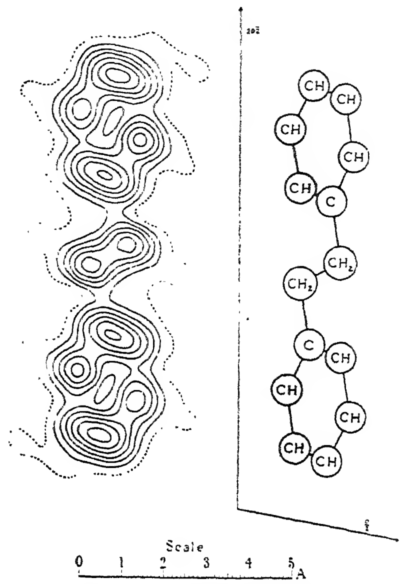

FIG. 3. Dibenzyl, projected along the *b* axis. Each contour line represents a density increment of one electron per square A.

I have now completed a double Fourier analysis of the structure factors for three such zones of reflections, and the results confirm my previous conclusions. The orientation given before is only slightly modified, and the shape of the molecule is verified. Calculations based on the Fourier analysis show that the planes of the benzene rings cannot be turned by more than about 8° from the three-dimensional position of Fig. 1.

A contoured map of the electron density for one of the projections (along the *b* axis) is given in Fig. 3, and it will be seen that six of the fourteen carbon atoms are clearly resolved. The remainder are resolved in other projections, so that nearly all the co-ordinates can be estimated directly from these maps. The regularity of the benzene ring is a rather striking feature of this particular map. It was obtained by summing a double Fourier series of about fifty terms at 450 separate points taken over the asymmetric unit (half the molecule).

The possibility that Dhar has examined a different crystal modification from the one dealt with by me must not be overlooked. My crystals melted sharply at 52°, and corresponded in every respect with the standard description.

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July 27.

[1] *Proc. Roy. Soc.*, A, 1934, in the press.
[2] *Current Science*, **2**, 480, June 1934.

Dietary Depigmentation of Young Rats

WHEN black (or hooded) young rats are given a ration containing much carbohydrate and also the vitamins B_1 (acid clay standard), B_2 (egg-white or horse-flesh), A and D (standardised cod liver oil), McCollum's salt mixture and the necessary amino acids (casein, egg-white or horse-flesh), they are liable to show symptoms of yellowish depigmentation of the fur after about two months. Symptoms are less pronounced if the carbohydrate contains much cellulose (wheaten bread, rye bread). If such diets

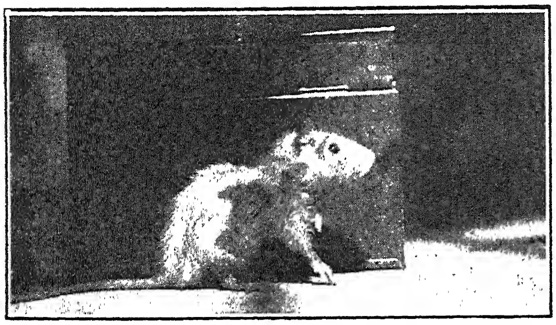

FIG. 1. Experimental rat, yellowish white with black sides.

contain much fat or sugar (cake), the symptoms develop more readily.

Rapid cure was not possible with any of the foodstuffs hitherto tried; only one rat was partly cured within a few weeks by the administration of lemon juice; two other rats exhibited a small improvement during the same period. Addition of whole, dried yeast, on the other hand, resulted at best in a very slow cure; the sides of the body improved first (Fig. 1), finally after two months the fur got back its original black colour. When the yeast was omitted afterwards, the rat showed symptoms of depig-

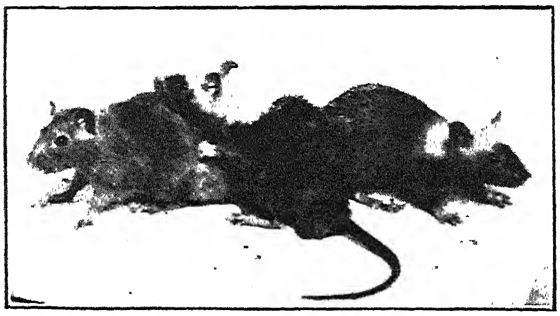

FIG. 2. Animal on left, yellowish grey; those on right black with bald head and neck.

mentation again simultaneously all over the body (Fig. 2, left animal). Sometimes there was loss of fur on the head, neck and back during this period of depigmentation (Fig. 2, two animals on right); the new hairs which appeared on neck and trunk before the cure started were more obviously yellow-tipped than the remaining old hairs which began slightly to turn pale by that time.

The symmetrical distribution of the returning pigment reminds one of the hyperpigmentation in pellagra of man (Lavinder[1]); the diet which causes depigmentation is probably deficient in the pellagra-preventive factor B_6 (György[2]) or the growth-promoting factor Y (Chick and Copping[3]); on the other hand, the alleged relation between pellagra and diets rich in sugar (Leader[4]) is in some measure corroborated by the above mentioned results. After all, the fact that lemon juice was active too suggests that vitamin C or some other active principle in lemon juice may play some part, although vitamin C itself is generally assumed to have no effect on the rat. One should take into account here the beneficial results obtained by Morawitz[5] with lemon juice as regards hyperpigmentation and scurvy of a human patient.

F. J. GORTER.

Delft.
Aug. 13.

[1] Lavinder, "Avitaminosen und verwandte Krankheitszustande", p. 684, Springer, Berlin, 1927.
[2] György, NATURE, **133**, 498, March 31, 1934.
[3] Chick and Copping, *Biochem J.*, **24**, 1764; 1930.
[4] Leader, *Biochem. J.*, **24**. 1172; 1930.
[5] Morawitz, *Klin. Wochenschr.*, **13**, No. 9; 1934.

Acceleration of Respiration of Normal and Tumour Tissue by Thionine (Lauth's Violet)

THE defective oxidation of carbohydrate by tumour tissue (Dickens and Šimer)[1] causes experiments directed towards its restoration to be of interest. It is now known that at least two types of reagent are able to function as catalysts in increasing directly the oxygen consumption of body-cells: (*a*) certain reversibly oxidisable systems, particularly methylene blue[2,3] and pyocyanine[4]; (*b*) the dinitrophenols, particularly dinitro-*o*-cresol, found by Dodds and Greville[5,6] to increase the respiration of surviving kidney and tumour tissue.

In the course of investigations of the action of reversibly oxidisable systems on the metabolism of normal and tumour tissue, I have found that this action of dinitro-*o*-cresol on the respiration of kidney tissue is apparently not a special property of the nitrophenols, but is shown also by the dyestuff thionine (Lauth's violet). Measurements were made in the Haldane-Barcroft-Warburg apparatus, and those of respiratory quotient in bicarbonate media by the method of Dickens and Šimer[7]. Thionine added to a lactate-containing medium in 5×10^{-5} M. concentration was found to cause an increase of respiration of surviving kidney of the rat amounting up to 90 per cent in phosphate- and up to 59 per cent in bicarbonate-Ringer solution; an example follows:

	R.Q.	Q_{O_2}	$Q^{O_2}_{CO_2}$	Extra oxygen	Extra carbon dioxide
Control	0·83	−27·5	−6·05	15·2	16·0
With thionine 5×10^{-5}M.	0·92	−42·8	−10·6		

Comparison of these figures with those given by Dodds and Greville[5] for dinitro-*o*-cresol shows an almost perfect analogy in the effect of the two substances. In both cases, the extra oxygen is used for the combustion of metabolite at or near *R.Q.* unity, and the increase itself is of the same order of magnitude. Thus a link is provided between the hitherto obscure action of the nitrophenols (or perhaps of products formed from these in the tissues) and that of the reversibly oxidisable dyestuffs. The respiration of kidney in presence of glucose is also increased by thionine.

The respiration of tumour tissue is increased by thionine in similar concentration. With Jensen rat sarcoma, increases of 48–146 per cent were observed in phosphate- and in bicarbonate-media containing glucose; in lactate, contrary to Dodds and Greville's experience with dinitro-*o*-cresol, both thionine and pyocyanine cause a fall.

A marked difference also exists between the behaviour of these three reagents towards the aerobic lactic acid formation in tumours; this is accelerated by dinitro-*o*-cresol[6], diminished by pyocyanine[4] whilst with thionine I find that it is possible to increase the tumour respiration by 146 per cent with little or no effect on the aerobic glycolysis. It may be mentioned that methylene blue in solution of high bicarbonate concentration at *p*H 7·6 caused an increase of respiration of the tumour, accompanied by a slight increase of aerobic glycolysis in some experiments. On the other hand, the more positive system, toluylene blue, in higher concentration, has been found, like ferricyanide[8], to lessen aerobic acid formation. These experiments are being continued and extended to other oxidation-reduction systems.

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[1] F. Dickens and F. Šimer, *Biochem. J.*, **24**, 1301; 1930.
[2] E. S. G. Barron. *J. Exp. Med.*, **42**, 447; 1930.
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[4] E. A. H. Friedheim. *Biochem. J.*, **28**, 173; 1934.
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Glutathione and Vitamin C in the Crystalline Lens

IN a recent letter, Evans[1] disagrees with our observation that a considerable part of the iodine-reducing substance in the crystalline lens is ascorbic acid[2].

In support of the view that the lens contains an insignificant amount of ascorbic acid, Evans refers to a biological test in which she added crystalline lens to the scurvy-producing basal diet of a group of guinea-pigs, and states that the experimental animals survived no longer than the negative controls, which "indicates that the lens contains only small amounts of ascorbic acid". On account of the present interest of these observations, we wish to point out that in a paper[3] not referred to by Evans we reported a demonstration of the presence of ascorbic acid in the lens of the ox by means of a biological method. It was observed at the time that the curative biological test gave no evidence of the presence of ascorbic acid in the lens, because the experimental animals died before the negative controls, presumably owing to a toxic action of the lens. The same objection holds against the prophylactic method which was apparently used by Evans.

In our final test, therefore, the tooth structure method was used, and the results indicated the presence of a considerable amount of ascorbic acid in the lens. It should be noted that the lens was given to the animals in doses calculated from the 2-6-dichlorophenolindophenol titre to contain 2·7 mgm. of ascorbic acid. Ground desiccated tissue was used and suspended in water for dosing from a pipette. If the lens is added to the diet (as in Evans's experiment), a serious error may be introduced by the oxidation of the ascorbic acid present.

Evans suggests that the Okuda iodine titration method is fairly accurate for estimating the glutathione content of crystalline lens, but also reaches the contradictory conclusion that the lens possibly contains another iodine-reducing substance apart from glutathione or ascorbic acid. In this connexion it may be observed that the rapid reduction of 2-6-dichlorophenolindophenol by an acid extract of the lens indicates the presence of a substance or substances *which ipso facto can also reduce iodine*. Therefore the iodine titration of the lens extract gives a measure not of the content of glutathione alone, but also of the glutathione and the indophenol-reducing substances together.

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[1] NATURE, **134**, 180, August 4, 1934.
[2] NATURE, **131**, 469. April 1, 1933.
[3] *Biochem. J.*, **28**, 638; 1934.

Hormonal Interruption of Broodiness in Hens

THE separation of particular hormones effecting broodiness in hens, which is very important from the economic point of view, has been studied by Hertwig and Schwarz[1] with negative results: menformon in quantities of 500 mouse units had no influence upon the interruption of broodiness.

In these experiments four groups of brooding hens and those which had discontinued their broodiness and yet were not laying eggs were used. Different hormones were administered, for a period of ten days. Prolan A, pituitrin and distilled water were administered subcutaneously and the thyroid gland by mouth. Prolan A was given in increasing doses up to a total of 1,600 mouse units; the second group was given dried cattle thyroid gland (0·5 gm. daily) and the third group, pituitrin (Dr. Heisler, Chrast, Czechoslovakia, 0·5–1·0 c.c.) amounting in all to 8 c.c., that is, 48 pigeon units. The fourth group, serving as control, received the same amount of distilled water.

The results show that: (1) the hormones in the amounts given had no influence upon the interruption of broodiness during the experimental period and seven days afterwards. (2) Thyroid gland produced heavy moulting on the fifth day of the experiment and this was continued for a period of seven days. However, the same quantity of thyroid substance had no effect upon the moulting of the breeding hens. (3) The hen from the prolan group, which was not broody but was not yet laying eggs, started to lay five days earlier than the others. (4) The pituitrin administered to hens in such large doses, which were large enough for a man, had no effect upon health, broodiness, or laying.

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[1] *Arch. Geflügelkunde*, **8**, 3; 1934.

Research Items

Roman Remains at Ipswich. A Roman villa at Castle Hill, Ipswich and a Roman cemetery in Messrs. Bolton's brickfield, Ipswich, are described by Messrs. J. Reid Moir and Guy Maynard in the *Proceedings of the Suffolk Institute of Archæology and Natural History*, 21, pt. 3. Ipswich and its immediate neighbourhood are poor in Roman remains, and, so far as is known, Castle Hill is the only habitation site of the period in the district. The remains uncovered were of considerable extent. The house faced south, overlooking the Gipping-Orwell valley. The shape is difficult to visualise. It may have been of an L shape. Most of the relics found on Castle Hill belong in date to the later half of the Roman occupation, and the evidence from the cemetery points to the same conclusion. On the Castle Hill site in two places there appeared evidence of two Roman levels, which, however, may not have been separated by any great length of time. Two somewhat extensive areas of tesselated pavement were uncovered, one a passage-way and room of plain red tesseræ and the other a room showing a simple form of decoration in black, red and white tesseræ. In a rubbish pit were two cooking pots of black ware, which had been used as cremation jars, a somewhat surprising occurrence for a period when cremation was not generally in vogue. The brickfield cemetery, judging by the pottery and other grave furniture, served the people of Castle Hill, as the remains are comparable in age, but the poor character of the material suggests that it was used only for those of small social importance. The graves were placed more or less in rows with the bodies orientated feet to west. They were in the extended position with the head on a pillow or surface soil, and the hands over the pelvis. In six instances (all females) the skull lay between the feet. Evidently they had been decapitated; while in two, humanly fashioned flints lay on the pelvic region.

Early Glass. All known examples of glass which can be dated to a period earlier than 1500 B.C. are enumerated by Mr. H. C. Beck in *Ancient Egypt and the East*, 1934, pt. 1. Glass, glaze and faience are all made of similar materials and have to be distinguished. Glaze has been made extensively from the Badarian period in Egypt, the Jemdet Nasr period in Mesopotamia, and from an early date in the Ægean, while faience is found in the pre-dynastic period at least as early as 4000 B.C. Glass was occasionally made before 1500 B.C., but specimens are very rare. There are twenty-eight reputed examples cited here; but some are not glass, others are of a more recent date, while others are doubtful. The most important piece of evidence is a block of glass from Abu Shahrein, in Mesopotamia, discovered by the late Dr. H. R. Hall, for which a date of 2700–2600 B.C. is claimed. It may have been intended for carving or remoulding. As a worker's piece, it is the earliest evidence pointing to the existence of a factory. A glass cylinder found by Dr. Frankfort at Tell Asmar, Mesopotamia, dated at about 2600 B.C., is of a pale blue-green colour. With the exception of a bead in the Berlin Museum, it is the earliest piece of clear glass known. These two pieces point very strongly to Mesopotamia as the country where glass originated. Two Egyptian specimens, though not the earliest, are the most beautiful of the early examples. One, a small lion head now in the British Museum, is a masterpiece of carving; the other, a rod with a cartouche, dated 2050–2000 B.C., is the only piece of glass mosaic, with the exception of the bull from Dahshur (xiith dynasty) of which the character of the material is disputed, that can be attributed to this early period. As a rule this technique was not employed until 1,500 years later.

Nest Mortality of Birds. The extent to which the elimination of individuals at different stages of their life-history takes place is involved in any theory of natural selection, but has not been sufficiently studied in terms of numbers. A contribution by S. Baron of the nest mortality of twelve common and diverse species of British birds is, therefore, of unusual interest (*British Birds*, Aug. 1934, p. 77). Summing up his results, he found that, in 74 nests, 287 eggs were laid. Of these, 77 were destroyed by human agency, 30 by natural causes. Of the 180 which hatched, 6 chicks were destroyed by human agency, 30 by natural causes, so that, from the 287 eggs which were laid, only 144 young birds reached the stage of leaving the nests as fledglings. The greatest mortality took place amongst blackbirds (32 fledged out of 91 eggs in 24 nests), magpies (5 out of 12 in 3 nests), and song-thrushes (29 out of 62 in 16 nests). The most successful hatchings occurred in long-eared owl (4 out of 5 eggs in 2 nests), wood-pigeon (6 out of 8 in 4 nests), and mistle-thrush (13 out of 17 in 5 nests). In those birds in which the greatest mortality occurred the larger part of the destruction was due to human agency. It would be interesting to know whether this was attributable to school-boy raiders or to deliberate means taken for the protection of crops or stock.

Scottish Marine Fauna. In a paper published last year, Mr. A. C. Stephen described the natural faunistic divisions of the floor of the Northern North Sea as illustrated by the distribution of the lamellibranch molluscs. By major differences in their density and in the identity of the dominant species Mr. Stephen was able to divide the sea floor into four well-marked zones. These are (1) the Littoral Zone—from high-water mark down to 2 fathoms; (2) the Coastal Zone —2–20 fathoms; (3) the Off-Shore Zone—lying beyond; and (4) the *Thyasira-Foraminifera* Zone—occupying the deep north-eastern portion of the Northern North Sea. In a recent paper ("Studies on the Scottish Marine Fauna: Quantitative Distribution of the Echinoderms and the Natural Faunistic Divisions of the North Sea. *Trans. Roy. Soc. Edin.*, 57, Pt. 3, No. 32; 1934) this author records the results of a similar study of the echinoderm population of the North Sea. He finds that these do not show groupings by density of population into zones, as do the lamellibranchs, but that the species of genera represented (mainly *Ophiura*, *Amphiura*, and *Echinocardium*) occur in the greatest numbers in the lamellibranch off-shore zone. It is suggested, therefore, that the echinoderm population might be used to subdivide this zone. In both of the above-mentioned papers the view is put forward—we believe with justification—that, in the North Sea at least, the distribution of the fauna of the sea floor is best regarded and described in terms of zones. The animal community concept, as evolved by Petersen,

though probably the more useful in shallow or enclosed waters, is held to be largely inapplicable to the bottom fauna of the North Sea.

Sponges and Cumacea from East Greenland. The zoological results of the Norwegian scientific expeditions to East Greenland (*Skrifter om Svalbard og Ishavet*, Nr. 61. Oslo, 1934) include reports on the sponges by Maurice Burton and on Cumacea by C. Zimmer. The study of the sponges gathered during expeditions in 1930, 1931 and 1932 by Paul Loyning has afforded the opportunity of making a preliminary survey of the distribution of arctic sponges generally, deep-sea and shallow-water species following different lines. The author states that it will be essential in the future, before any comprehensive work on the zoogeography of sponges generally can be begun, for more attention to be paid to the bathymetric distribution. The collections show that there is a remarkable connexion between the arctic fauna and that of the Indo-Pacific and sub-antarctic regions, for there is a number of species common to Greenland and Africa, Australia and the Antarctic; 15 are confined to the arctic region, 54 species in all being recorded, of which one is new to science and 26 new to the fauna of Greenland; 43 are recorded from the area north of lat. 71° 30′ N. for the first time. Most of those not confined to the Arctic suggest a line of distribution extending southwards along the west coast of Europe and Africa, around the southern extremity of the African continent, through the Southern Ocean to Australia (and perhaps to New Zealand). The line may extend to the Antarctic. *Stylocardyla borealis*, with four sub-species, has a peculiar distribution, sub-species *typica* occurring in the Arctic, Western Europe, along the eastern coast of North and South America as far south as Bahia, off Japan and between Marian and Crozet Islands. Probably it is equally distributed throughout the Atlantic. The distribution of the other three sub-species is more like the shallow water forms. It is suggested that these four sub-species are of recent origin, *acuta* still spreading and *irregularis* restricted, and probably the last to arrive.

Pairing in Starfishes. H. Ohshima and H. Ikeda (*Proc. Imp. Acad., Tokyo*, 10, No. 2; 1934) record observations made in July 1933 on the tropical starfish *Archaster typicus*, which occurs in hundreds on the shore of Ishigaki Island. The superposition of a male starfish on a female, first noticed by Boschma (1924) and confirmed by Mortensen (1931), was found to occur here. With the receding of the tide, the starfish crept about in search of his mate, and when the sandy bottom became exposed the starfish were found in couples on the sand; as the sand became nearly dry the mating couples hid themselves under the sand. When the tide rose and the sea bottom was again flooded with water the upper starfish detached itself from the lower one and crept away. Microscopic examination of the gonads showed that in more than 180 couples the underlying starfish was female and the upper one male. A few exceptions were observed—8 examples of superposition of male on male and 3 of female on male. No case of female on female was found. Other unusual cases were 12 sets of three superposed individuals and 4 sets of four superposed individuals; in each set only the lowest specimen was female. It seems probable that the act of superposition is repeated at each high tide, and eventually the spawning takes place on some stimulus. The close association of male and female will make the fertilisation of the eggs certain. The authors recall the few known cases of pairing in Echinoderms.

Movement of Sap in Trees. Prof. George J. Peirce, of Leland Stanford University, made this the subject of his presidential address to the Botanical Society of America at its meeting in Boston in December 1933 (*Amer. J. Bot.*, 21, 211–227, May 1934). Prof. Peirce has used starch suspension and other fine suspensions in injection experiments with trees, and he attaches considerable importance to the fact that it is frequently possible to inject the tracheal systems of the tree to a very considerable extent. He has thus been led to the view that the movement of water in these tracheal systems may take place very largely in hollow tubes of water in the tracheæ, rapid movement being possibly either in such films of water or in the vapour within. He dissociates himself from the classical view of Sachs that water movement takes place through the wall, but at the same time points out some of the difficulties in the way of the current assumption that movement is taking place in continuous columns of liquid that fill the tracheæ. Prof. Peirce's address maintains the contact between the physico-chemical problems involved and the biology of the living tree. His view that the anatomy of the tree may have direct relation to the possibility of maintaining the supply of water to the crown of foliage under adverse conditions should certainly stimulate further inquiry and discussion.

Acceleration of Flower and Fruit Formation. In continuation of the work on flower and fruit formation referred to in NATURE of August 18, p. 257, it may be mentioned that a preliminary notice by R. Harder and I. Störmer has recently been published ("Blütenentfaltung und Hormonwirkung", *Nachr. Gesell. Wissenschaft. Göttingen, Math. physik. Klasse, Fachgruppe* 6, *Biologie*, N.S., 1, No. 3). The detailed paper will appear in the "Jahrbuch für wissenschaftliche Botanik". In this notice, the authors give a short account of a large number of experiments with flowering plants, including those used by Schoeller and Goebel and others made in order to repeat Schoeller's investigations. But in no case did they get any positive result. They experimented with about 1,300 individual plants, and their investigations seem to have been carried out with the utmost care, but the conclusion is that the hormone has no influence at all. It is emphasised that such experiments can only give trustworthy results when the number of individual plants subjected to treatment and also the number of controls are very great; otherwise it is not possible to know how far the deviation from the mean goes in plants which have not been submitted to treatment.

Evolution of Coal and Oil. In two recent papers (*Proc. Roy. Soc. Edin.*, pp. 115–120 and 121–134; 1934) Prof. H. Briggs sets forth (*a*) the considerations leading to the conclusion that both coal and petroleum probably have a common origin in vegetable matter of a peat-like character; and (*b*) the divergent courses of chemical development responsible for the production of two contrasted series of products. He presents evidence that coal up to the semi-bituminous rank is produced by chemical processes that involve the expulsion of carbon dioxide, methane and water.

During the further change to anthracite, however, water is consumed, the hydrogen being expelled as methane and the oxygen as carbon dioxide. This recalls the statement by Prestwich that: "While it requires a red heat to convert coal into coke, its conversion into anthracite is effected in presence of moisture at much lower temperatures". In the natural evolution of graphite from peat of average composition, the amount of graphite produced is estimated to be 29 per cent by weight of the original peat. The generation of oil from peat involves the consumption of water throughout the evolutionary range. Again carbon dioxide and methane are expelled. It is presumed that pressure and warmth assist the reactions.

Preparation of Protoactinium. Protoactinium (element 91) has a halving period of about 32,000 years, and may therefore be obtained in weighable quantity. G. Graue and H. Käding, working in Hahn's laboratory, have prepared nearly pure protoactinium potassium fluoride containing half a gram of the element (*Naturwiss.*, 22, 386; 1934). $5\frac{1}{2}$ tons of Joachimstal radium residues were worked up. The protoactinium was precipitated with zirconium as phosphate in the earlier stages, partly freed from zirconium by fractional crystallisation and precipitated together with tantalum. The final stages yielded a protoactinium compound which gave no X-ray spectrum of foreign element. 5 mgm. of this protoactinium has been used by H. Schüler and H. Gollnow (*Naturwiss.*, 22, 551; 1934) to investigate the hyperfine structure of the spectrum of the element. This is the first determination of the nuclear spin of an element belonging to a radioactive series, and the nuclear moment was found to be 3/2. The existence of hyperfine structure has always been found to be associated with an *odd* atomic weight, and since protoactinium loses six α-particles in changing to lead, the atomic weight of the lead isotope produced must be 207 (the only odd isotope) and that of the protoactinium must be 231.

The Cryoscopy of Milk. The detection of added-water in milk is one of the most important and difficult problems confronting the public analyst. Genuine samples may fall below the legal limit of 8·5 per cent solids-not-fat, and samples may be above this minimum standard and yet have added-water. Freezing-point determinations, however, give results of real value with practically all milks, but have the disadvantage of requiring considerable skill and experience. Attempts have, therefore, been made from time to time to devise methods by which the freezing-point (or the osmotic pressure on which it depends) can be calculated from the analytical data. J. J. Ryan and G. T. Pyne suggest a molecular constant for this purpose, calculated from the combined values of three variables—refractive index of the milk serum, and content of chloride and of soluble phosphate—and give full details for their determination (*Sci. Proc. Roy. Dublin Soc.*, 21, p. 113; 1934). The formula used is $W = 100 \times (33{\cdot}1 - (K\triangle))/K\triangle$, where W is the percentage of added-water, $K\triangle$ the molecular constant found, and 33·1 its average value for genuine milks. Genuine milks were found by this method to vary from the constant by not more than 3·5 per cent, and to compensate for this variation a deduction is made of 3 per cent from the added-water found. For five milk samples to which 5, 10, 10, 15 and 20 per cent of water had been added, the amounts found by this method were 6·4, 11·1, 11·2, 16·3, and 20·6 respectively, a very satisfactory agreement. The results in their present form apply only to fresh milk samples.

Phthalocyanines. R. P. Linstead and collaborators (*J. Chem. Soc.*, 1016; 1934) have investigated a new class of coloured organic compounds which comprises a parent substance, phthalocyanine, and a number of complex metallic derivatives, having a new structural type. The parent substance has four C_8 units in the molecule and is regarded as a fusion of four *iso*indole rings with extra cyclic nitrogen atoms. The first compound, crude iron phthalocyanine, was accidentally obtained in the works of Scottish Dyes, Ltd., in 1928. The reaction between cyanobenzamide and magnesium gave a crystalline magnesium phthalocyanine, $(C_8H_4N_2)_4\,Mg,\ 2H_2O$, which was also obtained from phthalimide, magnesium and ammonia. Many metals and metallic derivatives also react with phthalonitrile to yield compounds of the phthalocyanine type. The copper phthalocyanine is obtained as a bright blue compound by treating copper with phthalonitrile, the formula being $(C_8H_4N_2)_4\,Cu$. This compound is very stable, resists fused potash and boiling hydrochloric acid, and may be sublimed at about 580° at low pressure in an inert atmosphere. The molecular weight of the magnesium compound was determined in naphthalene by the ebullioscopic method as 538–565, the value for $C_{32}H_{20}O_2N_8\,Mg$ being 572. The close similarity between phthalocyanines and porphyrins, which form the basis of many important natural colouring matters, is pointed out, including the order of stability of the metal derivatives.

Structures of Halogen Compounds of Non-Metals. From time to time, certain halogen compounds of non-metals have been represented as polar compounds; for example, phenyl dichloroiodide, sulphur tetrachloride, phosphorus pentachloride, iodine trichloride and similar compounds: $[C_6H_5I\,Cl]^+\,Cl^-$; $[Cl_3S]^+\,Cl^-$; $[Cl_4P]^+\,Cl^-$; $[Cl_2I]^+\,Cl^-$. The evidence in favour of these formulæ is largely theoretical, and considerable doubt has been thrown on such representations by investigations of Zappi and Cortelezzi (*Bull. Soc. Chim.*, 1, 509; 1934). These authors find that solutions of phenyl dichloroiodide in carefully purified nitrobenzene and phosphorus oxychloride show a very feeble electrical conductivity, whilst the cryoscopic molecular weight is low. The interpretation suggested is that the dissociation is not electrolytic but follows the equation $C_6H_5ICl_2 \rightleftharpoons C_6H_5I + Cl_2$. A critical examination of the data for the other compounds shows that the cryoscopic dissociation is also probably molecular and not ionic. The feeble conductivities observed are more rationally explained as due to the dissociation of complexes formed with the solvent. The conductivity of iodine in liquid hydrogen sulphide is similarly explained by the equation

$$SH_2 + I_2 \rightleftharpoons H_2 = S = I_2 \rightleftharpoons (SH_2I)^+ + I^- \rightleftharpoons (SH_2I)^- + I^+.$$

The measurements indicating a conductivity of phosphorus pentachloride in nitrobenzene are regarded as subject to large errors, and the fused pentachloride, according to Voigt and Biltz, is entirely non-conducting. The polar formulæ are, therefore, in complete disaccord with actual electrochemical measurements, and should be abandoned.

Marconi's Wireless Pilot

By Commander E. C. Shankland

DURING the last two decades, experiments have been made on wireless fog beacons, one of which is known as the revolving beam and another as the rotating loop. Navigators are not fully satisfied with these forms of fog signals, neither do the signals give a direct lead of sufficient reliability into a port. The Marchese Marconi's latest wireless invention recently demonstrated in Italy to a party of guests representing shipping and scientific interests of Britain and Italy definitely supplies this need.

The device consists of a beacon situated on the shore (a promontory 300 ft. above sea-level) and a receiver fitted to the ship. Its intrinsic reliability is also better than the direction-finding apparatus hitherto invented because it is simpler as regards both transmission and receiving. The wave-length used is 60 cm.

To envisage the application of the transmission, one may adopt the analogy of twin searchlights on a single mounting with a dark zone between them in the centre, covering an arc of horizon of 269° with their beams, each beam right and left having a distinctive characteristic. The wireless transmitters send out signals at 500 and 1,500 vibrations per second in exactly opposite phases, producing a 1° zone of silence. This silent zone at 10 miles would subtend a band of silence of about 355 yards.

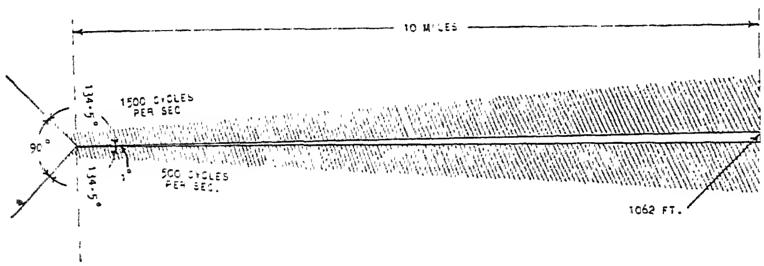

FIG. 1.

To have such a signal fixed in position would be unsatisfactory, as a navigator might assume he was in the silent zone when a breakdown had occurred and the transmitter was not functioning. To guide a ship safely therefore, and also to inspire the confidence produced by positive signals, the system is continuously swung from left to right of the centre line in a similar manner to a searchlight when looking for an object on the water. The amplitude of the swing is small, namely, 6°. When swinging to the left the beacon sounds a high note, when swinging towards the right it sounds a low note. The change of note takes place when the zone of silence coincides with the line of the entrance of the harbour. With this arrangement it is possible to ascertain immediately if the ship is either on the left or right side of the safety line or exactly at it. The rise and fall of the note gives a distinct cadence, to accustom the ear to which requires a certain amount of practice. A principal factor in the sound indication therefore lies in the change of note. If the ship is out of the correct course, the change becomes perceptible, one change of note becoming stronger than the other. It is claimed that this rate of change of tone is given to half a degree of the variation in the course by compass.

Experiments have shown that the apparatus is effective for a distance of 25 miles but the recent tests were conducted over a range of 10 miles, which is the distance between Santa Margarita and the beacon station at Sestri Levante. The strength of the signals varies approximately as the square of the distance from the source.

The transmission apparatus is about 6 ft. high and 4 ft. wide. Two small aerials and reflectors are mounted at right angles to each other on a platform forming the top of a cylindrical base. The platform and the aerial system swings left and right continuously about 2 inches from the centre line. The aerials and reflectors are set for horizontal polarisation of the waves. The small rotating transmitter and the mechanical gear swinging or rotating the beacon platform are both housed in the cylindrical base.

The transmitter is of recent development and has satisfied the conditions of working by operating for five months without attention. It uses two 100 watt special transmitting valves also of a recently perfected type. The remainder of the transmitting station consists of a loud speaker, small motor generators to supply the low- and high-tension to the equipment and to the controlling panels. The latter are housed in the tower. The beacon itself on top of the tower is therefore under remote control.

The receiving equipment consist of two receivers installed on the roof of the navigating house of the *Elettra* at approximately 30 ft. above sea-level. The distance for reception depends considerably on the height of the receivers. These are controlled from the wireless cabin. A repeater device is installed on the navigating bridge together with a microphone with its amplifier. The receivers are about 3 ft. high and only a few inches wide, and in their structure is incorporated an aerial, a small reflector, the tuning circuits and the receiving valves. They are mounted on two separate platforms which may be turned in any desired position. The angle of reception of these receivers is very wide (about 100°), so that it is only necessary to orientate them roughly on the beacon station. With these two receivers the beacon may be received in any position of the ship relative to that of the beacon. The repeater consists of a special milliamperemeter and a loud speaker. One side of the dial of the meter is painted green, the other side is red. In response to the radio signal, the needle oscillates continuously from left to right. When on the exact line of entrance, the change of tone occurs at the same time as the needle occupies its centre position and the deflection of the needle shows the same amplitude on either side. Any deviation from this normal condition indicates that the ship is either too much to the left or right of the line of entrance.

Attached to the system which guides the ship into harbour is a sound-ranging device which gives the distance of the ship from the entrance to the harbour at certain intervals if required. This is done by arranging the modulation of the beacon transmitter in such a way that one change of tone is missed every

15 sec., the next one being sent simultaneously as a radio signal and as an acoustic signal, the latter by means of a loud speaker oriented in the direction of the harbour. By measuring with a stop watch the time elapsing between the radio signals and the sound signal, the distance is known. To render this practical, the ship is equipped with a special microphone tuned to the note sent by the beacon and the head telephones of the observer can be switched over automatically from the radio set to the microphone.

The apparatus is clearly capable of uses other than providing a 'bee' line course for a ship entering harbour in fog. The transmitter may be swung in azimuth to any bearing to provide a silent zone upon which a ship may navigate at right angles if necessary.

Researches on Glasshouse Plants

THE nineteenth annual report (1933) of the Experiment and Research Station established by the Nursery and Market Garden Industries' Development Society, Ltd., at Turner's Hill, Cheshunt, Herts, shows a gratifying co-operation between the glasshouse grower and the scientific worker. The director of the Station, Dr. W. F. Bewley, reports that manurial and variety trials of tomatoes have been prosecuted for some time, and various items of practice, such as planting in trenches, digging in spent hops, chrysanthemum roots and clean straw, have been investigated. A very important experiment relates to heating the soil. This was done by means of hot-water pipes buried in the ground. Circulation of water in the pipes was maintained by means of an electric pump controlled by a soil thermostat. The results show a considerable increase in yield due to the higher temperature of the soil. The use of oil fuel has been investigated through two seasons, and an increased financial return of more than £210 per acre was obtained as against the use of anthracite fuel. This was due to the uniformity of temperature which was maintained throughout the whole of the day and night. Experiments on cucumbers and lettuce find a place in the report, which also contains, within its 115 pages, detailed results of mycological, entomological and physiological investigations by members of the Station staff.

Many short descriptive and research papers of interest to mycologists and entomologists appear in the report. On p. 39, Mr. P. H. Williams writes on leafy gall of the chrysanthemum, discussing its etiology and methods for control. Dr. W. F. Bewley and Mr. O. B. Orchard have a short note on rose diseases, and Mr. H. G. White describes vegetable diseases, including grey mould (*Botrytis* rot or wilt) of lettuce, bean wilt, and a disease of rhubarb. The same author also writes on the sterilisation of lettuce seeds. Messrs. O. B. Orchard and W. H. Read describe the control of leaf mould of tomatoes by fumigation with sulphur or quinone. Several virus diseases form the subject of a contribution by Dr. G. C. Ainsworth, and physiological investigations of mosaic disease of the tomato have been prosecuted by Mr. W. H. Read.

Mr. E. R. Speyer contributes articles on the red spider mite, the tomato-moth caterpillar, parasites of the tomato-moth, thrips and millepedes. Mr. O. B. Orchard writes on the control of wireworms and millepedes, and upon the joint destruction of tomato leaf mould and red spider mite, for which a combined insecticide and fungicide has been suggested. The Station continues to propagate and distribute a parasite of the greenhouse white fly.

The report also contains several contributions upon soil conditions and plant growth in glasshouses. Dr. O. Owen has investigated the leaching of nitrates and potash from soil used for growing tomatoes. Nitrates are not present in the drainage from heated soil in such large quantities as they occur in unheated soil, whilst the addition of spent hops has the effect of increasing the amount of nitrate in the leachings. The effect of manurial treatment on the nitrogen contents of some market garden crops has also been investigated by Dr. Owen. Mr. B. D. Bolas contributes a paper on the influence of light and temperature on the assimilation rate of seedling tomato plants, whilst Mr. R. Melville has studied the effect of water content of the plant upon assimilation. Some aspects of translocation in the seedling tomato plant are described by Mr. I. W. Selman. Messrs. W. H. Read and O. B. Orchard have a paper on plant injury following the burning of sulphur in glasshouses, and Dr. W. F. Bewley and Messrs. Read and Orchard report the results of numerous experiments on conditions which affect the quality of tomatoes.

Heavy Hydrogen and Heavy Water

A SURVEY of the applications of heavy hydrogen in research has been published by H. S. Taylor (*J. Franklin Inst.*, 218, 1; 1934). The method of preparation of pure deuterium oxide by electrolysis is described, with full experimental details, and the properties enumerated. The density is found to be ${}_{25}D^{25}$ 1·1079, in contrast to the value 1·1056 found by G. N. Lewis and Macdonald, whilst the freezing point, + 3·82°, is in good agreement with that found by the latter experimenters.

Pure heavy water is very hygroscopic, and readily absorbs moisture from the air and from containing vessels. Mass-spectrographic results show that the ratio of deuterium to hydrogen in ordinary rain water is 1 : 5000. The ratio of the isotope of mass 3 ($H^3 = T$) to deuterium (D) in the gas from the electrolysis of the best samples of heavy water is less than 1 : 50,000, and in ordinary water less than $1 : 5 \times 10^8$.

The equilibrium $H_2 + D_2 \rightleftharpoons 2HD$ is of importance in the study of surface catalysis. Glass, mercury, charcoal, etc., are inactive in promoting the reaction, but active nickel and charcoal oxide induce the change even at the temperature of liquid air, the activities of the surfaces being quite specific. A summary of the results on the biochemistry of heavy water is given. The enzyme catalase is only half as active in 85 per cent deuterium oxide as in ordinary water. Bacteria, as contrasted with protozoa and rotifers, are not killed. Compounds of deuterium other than the oxide are known, and a detailed

account of the properties of the deuteroammonias, NDH_2, ND_2H and ND_3, is given.

Experiments on the hydrolysis of palmityl chloride and the enzymic hydrolysis of triolein, on the effect of heavy water on the respiration and fermentation of yeast, on xanthin oxidase, and on the cytochrome-indophenol oxidase system, as well as on the swelling of gelatin, have been reported by Rideal, Hughes, Yudkin and Kemp (*J. Chem. Soc.*, 1105; 1934). The results with yeast confirm the result found by Pascu that heavy water possesses toxic properties. No effect on the rate of hydrolysis of palmityl chloride or triolein was found, nor on the activity of xanthin oxidase or cytochrome-indophenol oxidase. The effect on the swelling of gelatin on replacing water by heavy water up to 90 per cent deuterium content was inappreciable.

University and Educational Intelligence

THE handbook of lectures and classes for teachers arranged by the London County Council for the session 1934–35 has recently been issued. Courses are being arranged in most branches of education, and will be given at various centres in London. Copies of the handbook and further information can be obtained from the Education Officer, The County Hall, Westminster Bridge, London, S.E.1.

DR. H. W. CHASE, Chancellor of the University of New York, spoke in his inaugural address on June 13 about the freedom of the individual as a condition of the advance of civilisation—a subject on which confessions of faith have been proclaimed on many occasions of late in American university circles, especially since the advent of the Hitler regime in Germany and the consequent eclipse of *Lehrfreiheit*. While insisting on the necessity for freedom in universities, Dr. Chase reminded his hearers of their obligation to maintain the scientific temper, especially in the fields of the social sciences, now attracting the labour of so many research workers. The address is reproduced in *School and Society* of June 23.

THE Advanced Studies Committee of the University of Oxford has recently published a collection of abstracts of dissertations for the degree of Ph.D. It is vol. 6 of a series of such abstracts and covers the period October 1932–December 1933. Since the institution of this degree in British universities in 1917, there has been no little uncertainty and controversy as to what it does and should imply, and its standard in relation to other post-graduate degrees; and the matter was three years ago considered of such importance and general interest that it was selected as one of the subjects for discussion at the Fourth Congress of the Universities of the Empire. These Oxford abstracts are full enough to give in many cases a fair indication of the standard of the candidate's work, their average length being about two thousand words. They are grouped under the faculty headings: physical sciences (27), biological sciences (3), modern history (6), medieval and modern languages (5), theology (2), *lit. hum.* (1), oriental languages (1) and social studies (1). Several are of wide general interest, notably a study by D. M. Eastwood of Somerville of "The Revival of Pascal in France".

Science News a Century Ago

British Association at Edinburgh

The Edinburgh meeting of the British Association was held on September 8–15, 1834. In the *Analyst* (London) it was stated that a dinner was held on the opening day at 5 p.m., attended by 350 persons, with Sedgwick as chairman. He proposed the health of M. Arago, the Astronomer Royal of France. In reply, "M. Arago dwelt on the advantages that must result from the union of the minds of Europe; he regarded it as the pledge of the peace of the world because intellectual supremacy daily acquires more direct power over the affairs of nations, and when the intellectual rulers are banded in friendship the nations subject to this influence cannot be forced into hostility". These sentiments, we read, produced considerable impression. Following the dinner, the inaugural opening of the meeting took place elsewhere, Sir Thomas Brisbane presiding.

The business of the meeting was dealt with by six sections: (1) Mathematics and Physics; (2) Chemistry and Mineralogy; (3) Geography and Geology; (4) Anatomy and Medicine; (5) Natural History; and (6) Statistics.

The subjects discussed in the Section of Mathematics and Physics ranged from capillary attraction, meteorology, magnetism and optics to engineering. Sir David Brewster described some experiments on reflection from crystals, Rennie submitted a report on hydraulics, and Scott Russell dealt with his observations of the traction of boats in canals. The chair in the Section of Chemistry and Mineralogy was taken by Hope, who was occasionally relieved by Dalton. In this Section there was a discussion on chemical notation, while Daubeny described experiments on thermal waters and the heating power of fuels, and Kemp dealt with the liquefaction of gases. Among those who contributed to the proceedings of the Section of Geology was Agassiz.

The Lord Provost awarded diplomas of the freedom of the City to M. Arago, Dr. John Dalton, and Dr. Robert Brown. Evening lectures were given by Dr. Lardner on Babbage's calculating machine; by Prof. Buckland on fossil reptiles; and by Prof. Whewell on phenomena connected with the tides.

Edinburgh as a Meeting Place

The secretaries for the Edinburgh meeting were Robison and J. D. Forbes. It was largely due to Forbes that the Association met at Edinburgh. A year previous he had written to Sir Thomas Brisbane and to Murchison advocating the claims of Edinburgh as opposed to those of Dublin, Bristol and Liverpool, and in his letter to Murchison he said: "Then as to Bristol, the idea is a new one. Liverpool was spoken of, but as far as I recollect, not the other, nor do I think it a good position. But putting this out of the question, what I object to is your calling Edinburgh a University town, and therefore that it ought not to follow Cambridge. This is quite a mistake. The University gives no character to Edinburgh, and I fear will give little to the meeting. You must be perfectly aware that it is not an academical place, and that the University has nothing to offer. It has no status, no funds, no power. In short, you must never think of the University when you come here, nor compare it in the remotest degree with Oxford and Cambridge. . . ."

Forbes and Vernon Harcourt

During the meeting Forbes entertained Whewell, Peacock and Vernon Harcourt in his house at Greenhill. Of the last he said in a letter: "I learn every year to look with more admiration and affection on that remarkable man; nor shall I ever cease to look back with peculiar satisfaction on that meeting at York which brought me first into connection with him. . . ." Forbes had every reason to be satisfied with the success of the meeting, for the treasurer, Taylor, was able to announce that whereas the membership at York had been 350, at Oxford 700, and at Cambridge 1,400, the membership at Edinburgh had risen to 2,200.

Exposure of Raingauges

Among the activities initiated by the British Association was the measurement of the quantities of rain falling at different heights above the ground. The observations were carefully made on a pole above the top of York Minster at a height of 212·9 ft., on the top of the Yorkshire Museum at a height of 43·7 ft., and on the ground near by; the second report on the subject was communicated at Edinburgh. It was clearly established that the recorded amounts decreased with height above the ground, the decrease being greater in winter than in summer. The cause, however, was completely misunderstood, the increased catch near the ground being attributed to the increase in size of the drops as they fell through the lowermost layers of air or, by Luke Howard, to the actual formation of new drops near the ground. The circumstance that the vertical decrease is greater in winter than in summer was attributed to a direct effect of temperature. It is now known that the true cause of the decrease of the catch of rain as the gauge is raised above the ground is the increase of wind velocity with height, the wind forming eddies which sweep the drops past the opening of the gauge. The effect is greater in winter than in summer because the average wind velocity is greater in winter.

Early Gold Mining in South America

In the course of his excursion in Chile in August and September 1834, Darwin visited both copper and gold mines. On September 13 he says: "we slept at the gold mines of Yaquil, which are worked by Mr. Nixon, an American gentleman to whose kindness I was much indebted during the four days I stayed at his house. . . . When we arrived at the mine, I was struck by the pale appearance of many of the men, and inquired from Mr. Nixon respecting their condition. The mine is 450 feet deep, and each man brings up about 200 pounds weight of stone. With this load they have to climb up the alternate notches cut in the trunks of trees, placed in a zigzag line up the shaft. Even beardless young men, eighteen and twenty years old, with little muscular development of their bodies (they are quite naked excepting drawers), ascend with this great load from nearly the same depth. A strong man, who is not accustomed to this labour perspires most profusely, with merely carrying his own body. With this very severe labour, they live entirely on boiled beans and bread. They would prefer having bread alone; but their masters, finding that they cannot work so hard upon this, treat them like horses and make them eat the beans. . . ."

Societies and Academies

PARIS

Academy of Sciences, July 16 (*C.R.*, 199, 173–248). J. VINOGRADOV: Some new results in the analytical theory of numbers. EMILE OSTENC: The ergodic principle in Markoff chains with variable elements. SERGE FINIKOFF: Projective deformation of a couple of congruences. M. MURSI: The values of the modulus of $\sigma(z)$ at infinity. ANDRÉ WEIL: A characteristic property of finite groups of substitutions. AUGUSTE LAFAY: The modifications of the Magnus phenomenon determined by the structure of the wind. Study of the effects of an air current on a polished rotating cylinder, with special reference to the existence of eddies in the air current. MME. EDMÉE CHANDON, EDOUARD BOUTY and ANDRÉ GOUGENHEIM: Time determinations obtained with the aid of an equal altitude instrument, with prism and impersonal micrometer. Results obtained using a Baillaud self-recording optical micrometer. Comparison of three instruments. VENCESLAS POSEJPAL: The formation of hydrogen in a vacuum. In a previous communication (*C.R.*, 198, 59) the author shows that certain hypotheses concerning the ether lead to the prediction of the formation of hydrogen in a vacuum. Further experiments are now described giving the effect of any hydrogen pre-existing in the tube. These show that any hydrogen pre-existing in the vacuum tube will not invalidate the interpretation given in the earlier note. MARCEL PAUTHENIER and MME. MARGUERITE MOREAU-HANOT: The study of an electrified space containing material particles. EDMOND GUILLERMET: The electrolysis of the chlorides of zinc and cadmium in methyl alcohol. JEAN SWYNGEDAUW: Study of the anodic depression in the electrolysis of gelatine. PIERRE FLEURY: An addition method for the exact study of the current given by a photoelectric cell as a function of the incident light flux. PIERRE SOUTY: The influence of circularly polarised light on the velocity of mutarotation of some sugars. A solution of a sugar giving mutarotation is divided between two polarimeter tubes and exposed to beams of dextrorotatory and lævorotatory polarised light. It is shown that the photochemical effect is asymmetrical. HORIA HULUBEI: Intense sources of protons applicable to transmutations. The use of palladium charged with hydrogen for the production of the protons necessary for certain transformations markedly simplifies the working method, and gives yields equalling or surpassing other methods The new technique can be extended to the production of deutons. JEAN AMIEL: The preparation and explosion temperature of some complex compounds of copper nitrate, perchlorate and chlorate with ethylenediamine. The chlorates explode with great violence on heating and might prove useful as primers. HENRI PARISELLE and F. CHIRVANI: The emetic of saccharic acid. JAMES BASSET: The synthesis of ammonia under very high pressures, above 1,000 kgm./cm.^{2}. The apparatus described and figured can work for long periods at permanent pressures between atmospheric pressure and 5,000 kgm./cm.^{2}. At pressures of 2,000 kgm./cm.^{2} and higher, the velocity of the reaction is increased to such an extent that the presence of a special catalyst is unnecessary. The presence of impurities in the gas mixture is less material; thus coal gas may be used as the source of the hydrogen. J. PRAT: The thermal decomposition of the

aryltrihydroxyarsonium chlorides. LÉON DENIVELLE: The neutral aryl sulphates. PAUL GAUBERT: Spherolites with helicoidal windings of the allantoins and their artificial coloration. F. DUPRÉ LA TOUR and MLLE. A. RIEDBERGER: The effect of temperature on the crystalline network of certain normal dicarboxylic acids. ANTONIN LANQUINE: The structure of the Provençal chains to the north-west and to the south of the grand canyon of Verdon. AURÉLIAN VLADESCO: Cultural experiments with ferns: the formation of an aposporous prothallus. AUGUSTE and RENÉ SARTORY, JACQUES MEYER and HANS BÄUMLI: The experimental reproduction of the cryptogamic diseases of paper. CH. CHABROLIN: The germination of the seeds of *Thesium humile* requires the intervention of saprophytic fungi. G. BARBIER: Negative absorption in soil, clay and humus. LOUIS GALLIEN: The determinism of the duality of evolution of the larvæ in *Polystomum integerrimum*. ARMAND DEHORNE: The active phagocytosis of the sarcolytes of the longitudinal muscles after the evacuation of the ovules in *Nereis diversicolor*. MLLE. ANDRÉE MICHAUX: The amounts of calcium in the lungs and kidneys of guinea pigs, normal and starved, suffering from acute or chronic scurvy. Observation of certain bladder troubles due to diet deficiencies. MME. MARIE PHISALIX and FÉLIX PASTEUR: The action of short waves on asp poison. KOHN-ABREST: Rapid toxicological examination for the alkyl halides (chloroform, carbon tetrachloride, etc.). Application to the detection of these products in the air. MLLE. LISE EMERIQUE: Vitaminosis A and the chemical composition of the animal. ALEXANDRE SALIMBENI and GEORGES LOISEAU: Concentration of the diphtheria toxin and anatoxin by means of freezing. FRED VLÈS, ANDRÉ DE COULON and ANDRÉ UGO: The statistics of survival in tar cancers of mice after removal of the tumour. Study of the toxic rôle of the latter.

CAPE TOWN

Royal Society of South Africa, April 18. P. W. LAIDLER: The archæology of the prehistoric settlements in the Heilbron area. W. E. ISAAC: Researches on chlorosis in deciduous fruit trees. The experiments were divided into the following five groups: experiments with lime; experiments with sulphur; experiments with manganese sulphate; experiments with manganese sulphate and mineral fertilisers; experiments with copper sulphate. In about 10 per cent of cases chlorosis tends to pass away. Copper added as copper sulphate solution in a concentration of about 20 p.p.m., seems to cure the chlorotic conditions. There are beneficial effects with lower concentrations. Additions of potash bring about an improvement in the trees. Additions of lime do not exert a beneficial influence, and thus the trouble would not seem to be due to excess of available manganese, aluminium or iron. The trees are not in any way suffering from a deficiency of manganese, and evidence is presented indicating that chlorosis is not due to a deficiency of magnesium. J. GORDON CRAMB: Smithfield implements from a Natal coast site. A. GALLOWAY and L. H. WELLS: (1) Report on human skeletal remains from the Karridene site. (2) A further note on human skeletal remains from the Natal coast.

SYDNEY

Linnean Society of New South Wales, April 18. H. M. R. RUPP: Notes on Australian orchids: a review of the genus *Cymbidium* in Australia. The variation in the number of recognised Australian species, from R. Brown's time to the present, is discussed, and causes for existing difficulties in determining certain species are suggested. A review is given of the variable species *C. canaliculatum*, R. Br., which is divided into five distinct forms in which colour-scheme and colour play the principal part. T. H. JOHNSTON: (1) Remarks on some Australian Cestodaria. Notes are given on the Cestodaria which are known to occur in Australia, namely, *Austramphilina elongata*, Johnston, *Gyrocotyle urna*, Gr. and Wag., and *G. rugosa*, Dies. (2) Notes on some monocotylid trematodes. An amended description of *Monocotyle robusta*, Johnston and Tiegs, is given. The parasite, together with the two species *M. dasybatis* and *M. minima*, is assigned to a new genus. *Monocotyle selachii*, MacCallum, is also placed in a new Merizocotyline genus. A. N. COLEFAX: A preliminary investigation of the natural history of the tiger flathead (*Neoplatycephalus macrodon*) on the south-eastern Australian coast. This is the principal food fish of this coast. Data were collected during a series of cruises, made in 1930 on privately owned trawlers operating from Sydney as a base; and the records of the trawlers previously controlled by the State in 1918–22 were consulted. A comparison of the years 1918–22 with hauls made in 1930 shows a considerable decrease in the amount of fish taken per hour's trawling. The evidence so far obtained is insufficient to indicate whether this is due to overfishing, to a migration of the flathead to less disturbed surroundings, or to a natural fluctuation.

ROME

Royal National Academy of the Lincei, March 18. T. LEVI-CIVITA: Stationary solutions of Pfaffian systems: the more significant case (2). G. ABETTI: Height of the chromosphere in 1933 and course of the solar cycle. Observations on 89 days during 1933 at Arcetri gave the mean height of the solar chromosphere as 10·68″, an increase over the 1932 results of 0·45″. At Madrid (31 days), the mean value 9·84″ was found, this being less by 0·01″ than the mean for 1932. The difference is probably due to the marked difference between the numbers of observations at the two stations. As in 1932, the height is greatest at the poles and least at low latitudes. The view that the new solar cycle has commenced, mentioned last year, is confirmed. U. BROGGI: An application of Borel's method of summation. F. CONFORTO: Construction of automorphous functions by means of infinite products (2). G. BARBA: Observations on the nuclei of Andreoli and of Evans. G. LAMPARIELLO: A noteworthy class of non-linear differential equations of the second order. (2) Analytical behaviour—resolutive development. R. EINAUDI: Waves of discontinuity combined with superficial elastic vibrations. F. TRICOMI: An intuitive interpretation of the rotor and of the condition of irrotationality. L. SONA: Dynamic actions of a translo-circulatory current investing a bilateral lamina (2). M. RENATA FABBRI: A particular solution of the equations of the motion of a heavy solid round a fixed point. A. ROSSI and A. IANDELLI: Crystalline structure of the compounds $LaMg_3$, $CeMg_3$ and $PrMg_3$. These compounds crystallise in the cubic system, the unit cell containing four molecules. B. L. VANZETTI: Structure of olivil and its derivatives. The structures of olivil and of the isomeric iso-olivil are discussed. M. CURZI: A species of *Aspergillus* with stellate ascospores. *Aspergillus stellatus*, isolated

from fermenting sansa, is described. V. PUNTONI: Development of *Anopheles* larvæ in the waters of sewers. Contrary to current opinion, these larvæ grow well in sewage, the organic suspensions of which furnish them with suitable nutriment. V. RIVERA: Further considerations on the biological action of metals at a distance. This action cannot be regarded as due to either the vapour pressure of the metals, or the very slight reduction of the penetrating radiation inside metallic containers, or the radioactivity of the metals. It is assumed that the effects observed are determined by secondary phenomena, including ionisation of the air, produced by the penetrating radiation. G. LUCHETTI: Contributions to the knowledge of the causes of 'intoxication' of soil. This is a true 'intoxication', caused by bacterial, fungal and plant metabolism.

VIENNA

Academy of Sciences, June 14. MARIETTA BLAU and HERTHA WAMBACHER: Physical and chemical investigations on the photographic detection of H-rays. Experiments with pinakryptol-yellow show that the desensitising power of a dye depends on the nature of the solvent in which it is used. It varies also with the oxygen content of the surroundings, the dye apparently acting as a catalyst of the oxidation, by atmospheric oxygen, of the silver formed photochemically. HANS PETTERSSON: Ultra-violet spectrum of radium emanation. By means of a special experimental arrangement, a number of new lines in this spectrum have been mapped. FRIEDRICH BÖCK, GUNTHER LOCK and KARL SCHMIDT: Perkin's synthesis of cinnamic acid. The effects of the temperature and time of the reaction, of the proportions between the three reagents, and of various substituent groups on the yield of product obtained by this synthesis, are studied. The view that benzylidene diacetate is an intermediate product in the reaction is shown to be erroneous. WILHELM SCHMIDT and ERNST BREZINA: Experiments on the action of air-suction arrangements in works. The results of small-scale tests bring out various important points, for example, the inadequacy—in almost all cases—of a hood over an open vessel when the vapour emitted is somewhat heavier or cooler than the air. The necessity of testing the air at a number of points in the room is emphasised. K. W. F. KOHLRAUSCH and A. PONGRATZ: Studies on the Raman effect (33). The Raman spectrum of organic compounds—poly-substituted benzenes (34). Benzoyl, α-toluyl and cinnamoyl compounds. The effect of a benzene nucleus on the extent and intensity of the carbonyl frequency and on the frequency of the nitrile group is similar to that of a conjugated C : C double linking. The order of the substituents of the CO group according to their constitutive influence on the CO-frequency is the same as that of the dipole moments. O. PAULSEN: Raman observations on dichloroethylene. Results are given which indicate that it is scarcely justifiable to speak of dichloroethylene as a definite equilibrium mixture. ROBERT WILLHEIM: Carbohydrate metabolism of carcinoma. The co-ferment peculiar to the malignant tumours or a substrate accompanying it causes the characteristic anomalies of the carbohydrate metabolism, and presumably the spreading of this co-ferment into the rest of the organism is responsible for the general disturbance of such metabolism. HANS HELLER and FRITZ F. URBAN: Neutralisation of the poisonous action of pituitrin in the organism. Experiments *in vitro* show that, if the specific adsorptive power of blood towards pituitrin is taken as unity, that of skeletal muscle and brain is 2–4, that of kidneys 10, and that of the liver 100–200. FRIEDRICH MORTON: Results of a journey to Abyssinia, Egypt and the Quarnero Islands in 1931–32. The plant-geographical relationships in these regions were investigated. EDGAR SCHALLY and FERDINAND NAGL: Observation of 'streaking' in chemical investigations (6). Streaking observed when liquids of similar refractive power are mixed. JULIUS PIA: Comparison of the anise Diplopore flora of Bosnia with that of southern Dalmatia. VICTOR F. HESS, H. TH. GRAZIADEI and R. STEINMAURER: Investigations on the changes in intensity of the cosmic ultra-violet radiation on the Hafelekar (2,300 metres). HANS MOTZ: Investigation of rubber by electron deflection.

Forthcoming Events

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (ABERDEEN MEETING)

Monday, September 10

At 10 a.m.—Capt. T. A. Joyce: "The Origin and Uses of Yerba Maté" (Presidential Address to Section H).
Prof. J. A. S. Watson: "Scientific Progress and Economic Planning in Relation to Rural Industry and Country Life" (Presidential Address to Section M).
Prof. H. E. Roaf: "Normal and Abnormal Colour Vision" (Presidential Address to Section I).

At 8.30 p.m.—Prof. W. L. Bragg: "The Exploration of the Mineral World by X-Rays" (Evening Discourse in MacRobert Hall, Gordon's Colleges).

IRON AND STEEL INSTITUTE, September 10–14. Annual meeting to be held in Belgium and Luxemburg.

Official Publications Received

GREAT BRITAIN AND IRELAND

Ministry of Agriculture and Fisheries. Agricultural Statistics, 1933. Vol. 68, Part 1: Report on the Acreage and Production of Crops and Number of Live Stock in England and Wales; with Summaries for Great Britain and the United Kingdom. Pp. 91+3 plates. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

The North of Scotland College of Agriculture. Calendar, Session 1934–1935. Pp. viii+124. (Aberdeen.)

London School of Hygiene and Tropical Medicine. Classified Catalogue of Books in the Library, including Departmental Libraries. Class B: Natural Science. Pp. iii+31. (London.) Free.

Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1933. Pp. ix+248. (London: H.M. Stationery Office.) 4*s*. net.

OTHER COUNTRIES

Punjab Irrigation Research Institute: Research Publications. Vol. 2, No. 3: A Study of the Flow of Water under Works on Sand Foundations by means of Models. By Dr. E. McKenzie Taylor and Harbans Lal Uppal. Pp. 28+7 plates. 4 annas; 5*d*. Vol. 2, No. 4: A Study of the Flow of Water under Works on Sand Foundations by means of Models, Part 2. By Dr. E. McKenzie Taylor and Harbans Lal Uppal. Pp. 5+3 plates. 3 annas; 5*d*. Vol. 2, No. 5: An Investigation of the Pressures on Works on Sand Foundations, I. By Dr. E. McKenzie Taylor and Harbans Lal Uppal. Pp. 14+8 plates. 1 rupee; 1*s*. 6*d*. Vol. 2, No. 6: An Investigation of the Flow of Water under Khanki Weir and the Pressures on the Floor. By Dr. E. McKenzie Taylor and Harbans Lal Uppal. Pp. 34+18 plates. 1 rupee; 1*s*. 6*d*. Vol. 4, No. 5: The Relation between Exchangeable Sodium and Crop Yield in Punjab Soils and a New Method of Characterising Alkali Soils. By Dr. Amar Nath Puri. Pp. 4+1 plate. 2 annas; 3*d*. Vol. 4, No. 6: A Simple Method for Determining the Reaction and Titration Curves of Soils. By Balmokand Anand and Dr. Amar Nath Puri. Pp. 4+3 plates. 2 annas; 3*d*. Vol. 5, No. 2: The Transmission Coefficient of Water in Natural Silts. By Dr. V. I. Vaidhianathan and Hans Raj Luthra. Pp. 12+3 plates. 5 annas; 7*d*.

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Problems of Social Biology

ONE of the prime needs at the present time is the development of research in the social and biological sciences on a scale commensurate with the prosecution of research in the physical sciences in the past. This would replace our ignorance of social change by the precise knowledge upon which effective control depends, and would also assist in dispelling the misunderstandings or misinterpretations of social and economic history which lie at the root of many prejudices and other influences opposed to rational change.

The plea for a wider orientation of research and especially for investigations on the biological side has been reiterated by industry itself, notably by Sir Harry McGowan in the Messel Memorial Lecture to the Society of Chemical Industry, and was eloquently expounded by Prof. J. S. Huxley in his recent book "Science and Social Needs" (London : Watts and Co., 1934). The prosecution of research in these fields is undoubtedly likely to throw light on the true causes of many perplexing social phenomena observed both in industry and society. More, however, is required if we are to check and overcome the tendency for man's capacity for collaboration in work, his belief in his social functions and sense of group solidarity, to be destroyed by rapid scientific and technical advance.

The demands made on management by the magnitude and complexity of industrial operations at the present time have been one of the many factors forcing attention on training for management and the supply of industrial leaders of the requisite capacity. The demands made on leadership are, however, equally great whether administration is concerned primarily with problems of industry or with those of government or society.

It is here indeed that we touch on one of the most acute dangers of all. So long ago as 1913, Brook Adams ("The Theory of Social Revolutions". London: Macmillan and Co., Ltd.), pointing out the tendency for civilisations to break down through administrative difficulties or defects, suggested that even then the possibility of maintaining administrative quality and consequently stability of social equilibrium was gravely in doubt. Many indeed of the problems with which we are surrounded and the ills from which society is suffering to-day bear unmistakeable witness that governments and administrations have been unable intellectually as well as morally to meet the

demands made upon them, and have failed to effect the adjustments to rapidly recurring changes in environment produced by scientific and technical advance. On this point Bavink has commented pertinently, observing that until now, no civilisation has had the knowledge we possess, which alone enables a complete insight into the deeper causes of cultural processes, and in particular into the decline of peoples. The first people to resolve to eliminate those causes, he asserts, will, unless every sign is misleading, rule the world.

The peril of the backward or belated mind in administration is one of the greatest dangers to the continuance of civilisation. No political form of government, from dictatorship to democracy, will avert the disaster if its leaders are incapable of assessing the various factors and acting with sufficient vision, vigour and courage to effect the necessary adjustments to changed social conditions. No feature of the lopsidedness of our development is more serious than the discrepancy between the way in which we have developed scientific research and the training of scientific workers, and the comparative neglect or failure of our attempts directed to the discovery and training of administrators of exceptional capacity. The country that first solves the problem of discovering the administrative élite and of maintaining working *moral* will infallibly outstrip the rest in the quest for stability, security and development. The universities of the world have scarcely begun, however, to think about the training of the new administrator.

These who, confronted by the problems presented by the rationalisation of industry, have lightly asserted that the human mind is incompetent ever to handle efficiently the problems of administration presented thereby, have overlooked the fact that no attempt has been made to discover and train the right type of administrator or even to eliminate factors or conditions which definitely hinder his discovery and training. They overlooked, too, the fact that national administration presents problems equally complex, demanding equally a knowledge of technical, biological and social facts for their solution, and that civilisation must produce administrators of the requisite capacity and knowledge, or perish.

There could, therefore, be no more opportune time than the present for the discussion of the relation between science and social problems. If the discussions at the Aberdeen meeting of the British Association have done no more than encourage co-operation between the scientific worker and the community, and foster a sense of social solidarity, if they have given a definite impulse to the education of society and its leaders as to the contribution which science can make to the general welfare and the importance of the scientific and technical factors involved in many of our national and social problems, if they can initiate a determined effort to face the problem of discovering and training leaders for industry and society of the calibre and capacity required, they will have done much to justify the vision of the Prince Consort displayed in his presidential address when the Association first visited Aberdeen in 1859. "We may be justified in hoping that, by the gradual diffusion of science and its increasing recognition as a principal part of our national education, the public in general, no less than the Legislature and the State, will more and more recognise the claims of science to their attention; so that . . . the State will recognise in science one of its elements of strength and prosperity, to foster which the clearest dictates of self-interest demand."

History and Medicine

(1) *The Rise of Preventive Medicine.* By Sir George Newman. (University of London: Heath Clark Lectures, 1931, delivered at the London School of Hygiene and Tropical Medicine.) Pp. ix+270+8 plates. (London: Oxford University Press, 1932.) 10*s.* 6*d.* net.

(2) *Great Doctors: a Biographical History of Medicine.* By Dr. Henry E. Sigerist. Translated by Eden and Cedar Paul. Pp. 436+60 plates. (London: George Allen and Unwin, Ltd., 1933.) 15*s.* net.

(3) *The Physician: as Man of Letters, Science and Action.* By Prof. Thomas Kirkpatrick Monro. Pp. viii+212. (Glasgow: Jackson, Wylie and Co., 1933.) 10*s.* 6*d.* net.

(4) *The Life of Edward Jenner, M.D., F.R.S., Naturalist and Discoverer of Vaccination.* By Dr. F. Dawtrey Drewitt. Second edition (enlarged). Pp. xi+151+6 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1933.) 6*s.* net.

(1) SIR GEORGE NEWMAN'S book represents the first series of lectures founded in the University of London by Mr. Charles Heath Clark, who died in 1926. The general scope of these lectures as decided by the Senate of the University was to include the educational, cultural

and humanistic aspects of preventive medicine as distinct from technical and manipulative training.

Of the twelve lectures of which the book is composed, the first deals with folk-lore, magic, custom and religion, which form the beginning of a science and art of medicine. The second lecture is devoted to the consideration of Egypt and the Mosaic law. The preventive medicine of the Egyptians as revealed in the Edwin Smith and Ebers papyri and the history of Herodotus included regulation of diet, meat inspection, purification of water, bathing and the sanitation of dwellings, while the Mosaic law involved eight great principles, namely, the institution of one day of rest in seven, cleanliness of the human body, the use of clean food, the protection of the water and food supply, cleanliness, conservancy and sanitation of camp life, the practice of circumcision, laws of sexual relationship and sexual health, and the prophylaxis and suppression of contagious disease.

The next two lectures are concerned with Greek medicine, both in its land of origin and as regards its dissemination over Europe. A sketch is given of the work of Hippocrates and his contemporaries, followed by an account of Greek medicine in Alexandria, Rome and the Byzantine Empire, and its transmutation by the Arabians. In the fifth lecture, which is entitled "The Middle Ages and the Black Death", the prevalence of famine, pestilence, ergotism, pellagra, deficiency diseases, leprosy and bubonic plague in Europe and Great Britain are described. In this period, measures for the prevention of epidemic disease were first introduced, consisting particularly in public control by law, notification, isolation and disinfection, as well as by quarantine and international co-operation.

The Renaissance and the rise of physiology form the subject of the sixth lecture, in which it is shown that the Renaissance was an efflorescence from many roots, namely, the Greek spirit and its curiosity and freedom, the Arabic infiltration, the influence of the twelfth century and its manors, monasteries and guilds, the rise of the universities, the unifying influence of the Papal Church, the rich thirteenth century, the Black Death, the arts of painting and printing, the fall of Constantinople, the voyages and discoveries of the world, the Medici at Florence and the Oxford Reformers. The advance in anatomy is illustrated by a comparison of the work of Vesalius with that of his predecessors, such as Galen and Mundinus, while the stimulus given to the study of anatomy and physiology by the great painters is exemplified by reference to the pictures of Giotto, Leonardo da Vinci, Dürer, Michelangelo and Calcar.

Consideration is next given to Harvey's work on the circulation of the blood and the new physiology which resulted therefrom, with special reference to Claude Bernard's theory of constant internal environment.

In the seventh lecture, which deals with clinical studies of communal disease, the remarkable contribution of the English medical practitioners in the seventeenth and eighteenth centuries to the underlying principles of preventive medicine is emphasised. Examples of this contribution are offered by the writings of Mead, Fothergill, Huxham, Haygarth and Heberden in infectious diseases; Fothergill, Lettsom, Cadogan and Willan in domestic hygiene and child welfare, Pringle in diseases of the army, Lind and Blane in the prevention of scurvy and other diseases of seamen, Baker in the prevention of lead colic, and, last but by no means least, Jenner and vaccination.

In the eighth lecture, which is concerned with pathology and bacteriology, the necessity of pathology to preventive medicine is illustrated by the work of Morgagni, Matthew Baillie, John Hunter, Bichat, Charcot and Ehrlich. The evolution of modern bacteriology and parasitology is then considered, starting with the earliest observers, such as Fracastor, Leeuwenhoeck, Bassi and Cohn, and continuing with the researches of Pasteur, Koch, Metchnikoff, Behring, Ehrlich, Laveran, Manson and others.

In the ninth lecture, which is entitled "The Application of Discoveries", Sir George Newman discusses successively the improvement of medical practice as illustrated by the prevention of such diseases as smallpox, anthrax, cholera, plague, typhoid fever, rabies and diphtheria, the medical control of the character of infection, such as personal contact, water supply, food and occupation, the application of physiology to industrial well-being, and the effect of anæsthesia and antisepsis on surgery.

The concluding lecture deals with the organisation of the medical profession in England as exemplified by the foundation of the College of Physicians, the organisation of medical teaching, the creation of medical societies, the passing of the Medical Act, and the establishment of the General Medical Council.

(2) In his biographical work on great doctors, which has been admirably translated from the second German edition by those expert interpreters Eden and Cedar Paul, Dr. Henry Sigerist, formerly professor of the history of medicine at Leipzig, and now holding the corresponding chair at Johns Hopkins University, has given a concise account of the life and times of fifty-six medical men from Imhotep to Sir William Osler. Representatives of Greek, Roman and Arabian medicine, the school of Salerno, the Renaissance and modern times have been skilfully selected, and a good

description has been presented of their work and historical background.

A bibliography of the most important recent works on the history of medicine and of the doctors described in the book is appended. The text is liberally interspersed with excellent contemporary portraits and other illustrations.

(3) In his fascinating little work on "The Physician: as Man of Letters, Science and Action" Prof. T. K. Monro has given biographical sketches of men with medical qualifications who have distinguished themselves in other ways than in the practice of medicine, such as literature, philosophy, the Church, administration, art, science, invention, law and politics, sport, piracy and crime. As regards the various departments of natural science, chemistry is represented by T. Andrews, W. Babington, T. Beddoes, J. Black, T. Clark, W. Cullen, H. Kidd, Marcet and Mayow; botany by R. Brown, Gerarde, Nehemiah Grew, I. Hill, Hooker, Sir Thomas Millington, Withering and Woodward; zoology by Buckland, Flower, Huxley and Sir Thomas Molyneux; geology by Atherstone, Bevis, Hutton, Mantell, John Millington and J. Parkinson; and astronomy by Bainbridge, Sir Thomas Maclear and R. J. Mann. Mention should also be made of Peter Mark Roget, at one time physician to the Manchester Infirmary, who in 1827 succeeded Sir John Herschel as secretary of the Royal Society, and Sir Hans Sloane, who was physician in charge of Christ's Hospital in 1694–1730 and president of the Royal Society in 1727–41.

The bulk of the work is devoted to British physicians, but about twenty-five pages are given to Continental and other foreign medical men, such as Pierre Belon, Clemenceau, Copernicus, Dioscorides, Emir Pasha, Haller, Helmholtz, Rabelais, Redi, Schiller, Sun Yat Sen and Swammerdam. The work concludes with a section on students of medicine who never qualified, such as Charles Darwin, Humphry Davy, Francis Galton, Goethe, Littré and Samuel Warren.

(4) Dr. F. Dawtrey Drewitt's "Life of Edward Jenner" contains a sympathetic account of Jenner's early life as a country practitioner, his observations on natural history, particularly in connexion with the hibernation of hedgehogs, the importance of earthworms, in which he anticipated Darwin, the habits of the young cuckoo, a description of which he gave to the Royal Society in 1788, and his introduction of vaccination, which naturally forms the bulk of the work. His early investigations in this connexion, the publication of his epoch-making pamphlet, the opposition which he encountered, and his final triumph are vividly narrated. The text is accompanied by portraits of Jenner and a facsimile of one of his letters.

Secret Societies in Melanesia

Malekula: a Vanishing People in the New Hebrides. By A. Bernard Deacon. Edited by Camilla H. Wedgwood. Pp. xl+789+24 plates. (London: George Routledge and Sons, Ltd., 1934.) 42*s.* net.

BERNARD DEACON was a brilliant young ethnologist who in 1925 went out from Cambridge to study the natives of the northern New Hebrides, and particularly of the large island of Malekula. After more than a year's intensive work he fell victim to blackwater fever and died. A paper published posthumously in the *Journal of the Royal Anthropological Institute* (vol. 57, 1927) on "The Regulation of Marriage in Ambrym" has already marked him out as a first-class investigator from whose loss ethnology has suffered much.

The main body of his work, now edited by Miss Camilla Wedgwood, is concerned chiefly with the south-western and north-western districts of Malekula, and is pregnant with significant and detailed material for the study of cultural history, sociology and ritual. There is much exact information regarding the workings of clan organisation, together with such matters as the 'wiping out' of distant relationships so as to legitimatise marriages between persons to whom this would otherwise be forbidden. Though there is no sensational discovery to compare with that of the six-class system of relationship on Ambrym, the many lists of kinship terms show signs of having previously had a class basis, though this does not always seem to have been the same. In one district, for example, the father's father's father is classed with the elder brother, while in another it is the father's father's father's father. Whatever class basis there ever was, has been destroyed owing to the existing system of patrilineal descent with local exogamy now present throughout the island, although towards the north there are increasing signs of matrilineal influence or, more probably, survival.

What chiefly claimed Deacon's attention, however, were the ritual performances and mythology of what he refers to as the "Secret Society culture", which, in common with the natives all over Malekula, who have no doubt whatever on the matter, he regards as the most recent addition to the many influences which go to build up the complex culture of this island. Among the many institutions connected with this culture is the public graded society, common, with variations in detail, to all districts of the island, and corresponding to the Banks Islands *Sukwe* described by Codrington and Rivers. In its south-western form,

it comprises more than thirty grades, and centres round the planting of wild canes, erythrina, cycad, croton and other bushes and trees, and the erection of images of wood and tree fern in the lower degrees, and in the higher of plain monoliths and finally stones carved to represent the human form, said to be the dwelling-place of the founder of the grade as well as of all previous initiates and, after death, of the spirit of the new candidate himself. Sacrifice of tusked boars is made to the central object erected, after which the candidate, assuming in the higher grades the rôle of a hawk, is invested with his new regalia and title and in some cases acquires a new fire.

A more secret graded society corresponds, through its closer association with the dead, together with the use of masks and secret noises, to the Banks Islands *Tamate*, while a third society presents a resurrection drama. The greatest mystery of all, and possibly the most important of Deacon's discoveries in Malekula, is the rite called the "Making of Man", based on a belief in culture-heroes corresponding to, but more highly developed than, the mythology centring round the Banks Islands legendary hero Quat. A unique feature of the legend in this part of Malekula is the fact that the chief hero, in one district spoken of as the creator, is in another said to have been buried sitting upon a flat stone seat within a "dolmen-like structure" covered with a mound of earth and small stones, and that "his body never decayed", while his two sons procreated a number of stones which gave birth to the founders of the ten "houses", into which the village is divided. These culture-heroes, said to have been white-skinned and narrow-nosed, are accredited with the manufacture of vessels of coarse pottery no longer made by the natives and now used in fertility and mortuary rites, the introduction of the dog, since lost until re-introduced by Europeans, and the making of the mortuary effigies for which this area is well known, the heads of which are formed of the deceased's own skull modelled with paste to represent his features while alive. It is further said that, unlike the natives of to-day, they were not cannibals. The "Making of Man" is a close mystery, the secrets of which are guarded from all but the clan magicians. Its chief object is the perpetuation of the human race, and, in the only district where Deacon was able, owing to the imminent extinction of the population (due, say the natives, to its discontinuance), to gain reliable information regarding it, its central features are the washing of the supposed body of the chief hero and his wife, and a council of magicians, each seated on the stone from which he is descended, followed by their incestuous intercourse with women of their own and neighbouring villages "which necessarily violates all rules of clan exogamy".

This "Secret Society culture" Deacon considers to have been brought to these shores in the "great sea-going canoes" which were in use until recently. It is to be regretted that he did not live to discuss the bearing of his own discoveries and their relation to similar beliefs and practices elsewhere.

Deacon was not only a skilled investigator and fine linguist, but also a shrewd observer of native character and an artist capable of appreciating the beauty of the dramatic ritual, dancing and music for which this island is unrivalled in Melanesia. It is impossible here to do justice to the great variety of subjects dealt with. There are sections on the village and village life, marriage and the relation of the sexes, warfare, birth and initiation (including the operation of incision with, in the north-west, its accompanying hoaxes), the ritual life of women, the ceremonial exchange of pigs, gongs and gong-rhythms, totemism, magic (including such matters as the psychological preparation of the sorcerer), and a final discussion on culture sequence in the Northern New Hebrides as a whole. While there is little new information regarding the artificial deformation of heads in the south-west, there are, on the other hand, considerable additions to our knowledge of the Big Nambas inhabiting the northern plateau of the island, who are alone among the peoples of Malekula in that they possess chiefs, drink kava and practise true circumcision. The book is well produced, with good maps and illustrations, and ends with a few native texts with literal translation, a glossary and index.

It is no easy task to give order to another's field notes. The editor has succeeded to the extent that the book is well arranged and makes good reading for the general reader, though much of what Deacon had himself already written up has been unnecessarily and not always accurately paraphrased. It is unfortunate that expert advice was not sought in handling the many native terms, which lose much philological significance through lack of division into their component parts. References to other published work are curiously inaccurate. These are, however, details compared with the almost complete absence throughout the text, despite the insertion of many of the editor's own observations, of any indication as to which parts of the work are Deacon's and which Miss Wedgwood's, thus robbing the book of much value for the student of detail. The only exceptions to this unfortunate omission are initialled footnotes and a few passages quoted direct from Deacon, mostly printed in small type.

Fluid Motion

(1) *Fundamentals of Hydro- and Aeromechanics: based on Lectures of Prof. L. Prandtl.* By Dr. O. G. Tietjens. Translated by Dr. L. Rosenhead. (2) *Applied Hydro- and Aeromechanics: based on Lectures of Prof. L. Prandtl.* By Dr. O. G. Tietjens. Translated by Prof. J. P. Den Hartog. Pp. xi+311+27 plates. (Engineering Societies Monographs.) (New York and London: McGraw-Hill Book Co., Inc., 1934.) 24*s*. net each.

THESE two translations of books published a few years ago will be welcomed by all students of aerodynamics who are not familiar with the German language. The material is based largely on lectures given by Prof. L. Prandtl in Göttingen, though considerable additions have been made by Dr. Tietjens himself. The treatment is wide without being exhaustive, particularly as regards the more recent practical applications of the theory, and its underlying principle is a reconciliation of the apparently conflicting aspects of theoretical hydrodynamics and practical hydraulics.

This synthesis has been made possible by a realisation of the limitations of the classical hydrodynamic theory of perfect fluids, by Prandtl's development of the conception of the boundary layer, and by the consequential conception that vortices may spring from the surface of a body, even when the action of viscosity is neglected in the general motion of the fluid. The distinctive character of these books arises from the fact that the effects of the viscosity and compressibility of a real fluid are not relegated to later chapters following on the theory of a perfect fluid, but on the contrary are continuously borne in mind in the development and interpretation of the theory.

The first volume is devoted to the theory of fluid motion, and presents a lucid development and discussion of the fundamental conceptions rather than a detailed account of the manifold possible applications of the theory. The analysis is developed largely in vector notation, which gives a concise form to many of the fundamental equations. The material covers a wide range, including brief excursions into meteorology and the operation of free balloons, but its greatest value lies in the discussion of those phenomena which distinguish the motion of a real fluid from the classical theory of a perfect fluid. The chapter on vortex motion is therefore of prime importance, and in this chapter clear explanations are given of the origin of vortices at a sharp edge, of the development of circulation round an aerofoil, and of the system of vortices arising from the instability of a surface of discontinuity. Another brief but important chapter deals with the application of the theorems of energy and momentum.

The second volume is devoted to the practical applications of the theory and conceptions which have been developed in the previous volume, and it is in this volume that Dr. Tietjens has extended the scope of Prof. Prandtl's lectures. Successive chapters deal with the flow in pipes, boundary layers, drag of bodies and aerofoil theory, and each subject is fully and ably treated, although at a few points it is noticeable that the latest developments are not included. Items of special interest in these chapters are the entry conditions for flow in a pipe, the discussion of turbulent flow in pipes and in the boundary layer, and the method of determining the drag of a body from measurements of pressure and velocity in the wake.

A final chapter is devoted to experimental methods and apparatus, of which the most interesting is the section dealing with the visualisation of flow phenomena. The book contains a large number of excellent plates illustrating the use of these methods to record the details of several interesting types of flow, including the development of the boundary layer and wake behind a bluff body and of the circulation round an aerofoil.

The translations of the two volumes are due to Dr. L. Rosenhead and Dr. J. P. Den Hartog respectively, and this arduous work has been done ably. Very few lapses have been noticed, but in the first volume it is unfortunate that the term *stream function* has been used for entirely different functions on consecutive pages, and in the second volume the discussion of methods of defining the thickness of the boundary layer has lost some of its clarity in the translation. Both volumes follow the German originals closely, the only important difference being that the derivation of the general equations of motion of a viscous fluid has been transferred from the second to the first volume.

Ocean Waves

Ocean Waves and kindred Geophysical Phenomena. By Dr. Vaughan Cornish, and Additional Notes by Dr. Harold Jeffreys. Pp. xv+164+26 plates. (Cambridge: At the University Press, 1934.) 10*s*. net.

DR. VAUGHAN CORNISH is well-known for his researches in the matter of water wave formation, and this new volume from his pen forms a serviceable and welcome addition to his previous work on "Waves of the Sea and other Water Waves". In the present instance, he has extended his purview to include waves in sand and snow, as well as tidal bores and other progressive waves in rivers. The book is a record of

observations carried out systematically and painstakingly over a period dating back to the beginning of the century, during which the author has made a number of voyages and visited various countries for the purpose of collecting data and gaining information. In part, his object has been to provide mathematicians with numerical data for the further development of the theory of water waves, and to enlist their interest in the progressive undulations of granular material. In this respect, he has had the assistance of Dr. Jeffreys to generalise and extend the results of his observations and measurements.

That the study of ocean waves is one of no little difficulty and complexity can be readily seen from an inspection of the photographs of the sea in turbulence reproduced in the book. Under conditions of so unfavourable a nature for taking observations as are provided by a ship in heavy weather, it is surprising that Dr. Cornish was able to obtain results in which visual estimates accorded so well with theoretical expectation. As regards maximum values, he records the occurrence in October 1921 of waves 70 ft. in height in the Pacific from the observations of Capt. Wilson, and he deduces from information supplied to him in connexion with a voyage of the *Majestic* across the Atlantic in February 1923, that the observations on that occasion were best satisfied by a range from 60 ft. to 90 ft., which gives a mean value of 75 ft.

The study of ocean waves occupies only a third of the volume under review and almost a quarter is taken up with a consideration of waves in sand and snow, formed and propelled by wind and current. For the investigation of sand waves, Dr. Cornish not only examined microscopically the shore drift at Bournemouth and Poole in Dorset, but he also went to Egypt to inspect the formation of desert sand dunes over large areas. Several interesting photographs are reproduced of sand waves at Helwan and Ismailia. As regards snow waves, Dr. Cornish sought his information in Canada as far west as Winnipeg.

From the foregoing brief statement it will be seen that there is a considerable wealth of observation in the book, and natural science is indebted to Dr. Cornish for the prolonged and patient research which he has made in a field presenting many difficulties, and which has not hitherto attracted any considerable body of workers.

B. C.

Short Reviews

Gmelins Handbuch der anorganischen Chemie. Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 59: *Eisen.* Teil A, Lief. 5. Pp. 847–1166. (Berlin: Verlag Chemie G.m.b.H., 1933.) 50 gold marks.

THE manufacture of commercial iron is a matter of such far-reaching importance and interest that no fewer than three issues of Part A of this work have had to be devoted to this aspect alone of the chemistry of iron. Now that the section on metallurgy is complete, we have available for the first time a comprehensive survey of the whole of the literature on this subject, and the compilers have good reason to be satisfied with the result. This part of the work has been entrusted to Prof. R. Durrer, president of the Institute of Ferrous Metallurgy in the Technische Hochschule in Berlin.

About one third of the volume deals with the theoretical developments which have resulted from a systematic study of the various technical processes by modern physico-chemical methods, and tribute is paid to the work of pioneers in this direction in England. The middle portion of the volume deals with cast-iron and cast-steel. Historical notes are given of the development of the various processes used and a detailed description will be found of the manufacture of different varieties of steel. The graphite-lined crucible, the cupola furnace, the reverberatory furnace, the Siemens-Martin furnace and the small converter are described in turn with copious references to original publications. Then follows a description of various alloys of iron used in the manufacture of steel; for example, ferro-silicon, ferro-manganese, ferro-molybdenum, ferro-tungsten, etc. Finally, there is a lengthy supplement containing material which has appeared since the publication of the earlier sections. Thus the literature on the metallurgy of iron has been completely revised to August 1933.

The presentation in attractive form of the available results of these researches must have been a very formidable task, and we should like to congratulate the compilers on the skill with which they have been able to relieve the monotony of figures and tables by the judicious choice of phase-rule diagrams and illustrations of modern plant. These diagrams are very clearly printed and greatly enhance the value of the work.

The A B C of Biology. By Prof. C. M. Yonge. Pp. ix+252. (London: Kegan Paul and Co., Ltd., 1934.) 4*s.* 6*d.* net.

THIS book is a worthy addition to the A B C series, and Prof. Yonge is to be congratulated on being so successful in what was undoubtedly a difficult task. Within recent years, biology has come much to the fore, not only in relation to teaching in the schools, but also as a subject of great interest to the adult public. As might be expected, many books on biology have appeared, and the subject treated from different points of view according to whether the author had in mind school instruction at various

stages, or the intelligent and inquiring adult. Of these two varieties, the latter probably presents the more difficult problem, the successful solution of which really requires a master hand.

Prof. Yonge's method of treatment is good within the limitation he has imposed on himself. The author points out that, within the compass of a book of this size, it is not possible to treat of plants and animals equally in relation to all the main branches of the subject. The plants, therefore, are dealt with only in the general account of living matter, and in a description of the interactions between plants and animals. The principal theme of the book is confined to animals, but the treatment is sufficiently broad and up to date, and is arranged in three sections, the mechanisms of life, the organism as a whole, and the organism of Nature. As might be expected from one whose work has largely consisted of studies on the activities of animals, and on animals living in their natural surroundings, Prof. Yonge treats of animals as living, doing creatures. The result is a very interesting and readable volume, with 50 illustrations, a reasonable index, and a useful short list of books for further reading.

The New Modern Gasworks-Practice. Being the third edition, entirely rewritten and greatly enlarged, of "Modern Gasworks Practice". By Alwyne Meade. Vol. 1: *Design and Construction of Gasworks, Carbonisation Plant, Mechanical Handling of Materials.* Pp. xiii+534. (London: Eyre and Spottiswoode, Ltd., 1934.) 50*s.* net.

LIKE most progressive industries, the town's gas industry, as a result of the developments of chemistry and engineering, exhibits rapid changes in its processes which can only be followed in the periodical literature. Moreover, the industry is already well advanced into its second century, and possesses an accumulated fund of almost traditional experience. There is clearly a place for a book which will at intervals bring into focus the old and the new technology. During the last twenty years, this had been done by "Alwyne Meade", and the appearance of the first volume of the third edition is a reminder that it has met the need. This volume deals only with the construction and operation of carbonising plant. Those interested in gas manufacture will remember that "Alwyne Meade" deals essentially with matters of fact, and is not an analysis of scientific principles. It is a work for the practical man and possibly the student of technology. So well is it known, that it is scarcely necessary to do more than indicate its reappearance, bigger and more comprehensive than before. H. J. H.

Commonwealth of Australia: Council for Scientific and Industrial Research. Catalogue of the Scientific and Technical Periodicals in the Libraries of Australia. Supplement 1928–1933. Edited by C. A. McCallum and D. W. I. Cannam. Pp. xx+453. (Melbourne: Council for Scientific and Industrial Research, 1934.) 5*s.*

THE original work, which was reviewed in NATURE of September 13, 1930, p. 392, and to which this is a supplement, was issued in 1930 by the Australian Council for Scientific and Industrial Research in the confident expectation that the work would be of material assistance to scientific investigators in Australia in locating sets of periodicals to which they have references. This expectation has been fully justified. The publication, which comprised about ten thousand items, has also proved useful as a check-list to enable librarians in Australia and other countries to complete their holdings of scientific journals.

Recognising that the usefulness of such a work depends on its being kept up to date, the Council has issued the present supplement, which has been prepared under the able editorship of Mr. E. R. Pitt, who supervised the compilation of the main work. This supplement, containing about seven thousand new entries, will prove of the greatest value to Australian scientific workers and librarians in their investigations. It will also be invaluable to their colleagues overseas as a first-hand record of Australian scientific and technical periodical literature.

S. C. BRADFORD.

Traité d'algologie: introduction à la biologie et à la systématique des algues. Par Prof. Pierre Dangeard. (Encyclopédie biologique, Tome 11.) Pp. 441. (Paris: Paul Lechevalier et fils, 1933.) 175 francs.

THIS volume is primarily a comprehensive treatise on the structure and morphology of the Algæ. It contains also useful summaries of recent work on their cytology, physiology, biology and fossil occurrence. In the absence of recent works of this character, it is a distinctly useful volume and may well become a standard work of reference. The morphological chapters are, on the whole, judiciously treated and the illustrations, often original, are good and well chosen. Where so much ground is adequately covered, it is perhaps ungracious to remark that the treatment is in parts rather uneven, notably in the chapters on algal physiology and on pure culture methods. Moreover, the Rhynic fossil algæ should certainly be mentioned in any chapter dealing with that subject, as they are the earliest the structure of which is known.

Forestry for Woodmen. By C. O. Hanson. Third edition. Pp. 238+12 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1934.) 6*s.* 6*d.* net.

THIS new edition of a very useful book maintains the general form of the second edition published in 1922, but the author has made numerous alterations in detail in order to fit it for present requirements. It was originally written for teaching purposes for use in forest schools, and it has well fulfilled its object all through, for the information given is in every way correct, concise, to the point and presented in a way that can be readily understood by a student. In addition to its value for teaching purposes, the book contains much information of use to everyone interested in forestry, and it should find a place on the bookshelves of all workers amongst trees.

Exploration of the Mineral World by X-Rays*

By PROF. W. L. BRAGG, O.B.E., F.R.S.

THE mineral world has supplied us with many of the most beautiful examples of crystal structure. Crystals grow best when the growth takes place in very constant conditions and very slowly, and these conditions are fulfilled in Nature in a way that cannot be rivalled in the laboratory. The beauty of natural crystalline forms has always attracted attention, and some of the rare and durable varieties have been prized, as jewel stones, as the most valuable of all natural objects.

The present is a suitable time to review our knowledge of the structure of the mineral world, because all the main types of minerals have been analysed. The existence of any well crystallised mineral has always been a challenge to those whose research is the analysis of crystals by X-rays. Nature provides us with such excellent material on which to exercise our technique. The first crystals to be analysed were minerals, rock salt, diamond, fluor, blende, pyrites and calcite. For twenty years, the inquiry has been pursued, and with the recent analysis of the felspars it may be claimed that the main survey has been completed. There are, of course, many fascinating points of detail still to be investigated, but we can summarise the general laws which govern the different structures composing the solid crust of the earth.

We may first inquire how it is that we are able to speak of minerals as a limited class of chemical compounds. The number of compounds that can be formed from the chemical elements is endless. Yet the number of mineral species is restricted, and if we except the rare kinds which are found in odd corners where very special conditions have existed, the number is quite small. It must be admitted that part of the interest in mineralogy has been the interest of the collector. The fun of making a collection would be spoilt if Nature kept on producing endless new varieties of minerals.

The minerals are limited in number because they are the last survivors of the wear and tear of ages. They represent matter in the ultimate state of equilibrium. They have sunk into so deep a pit of low potential energy that no chemical change can tempt them to desert it.

This state of lowest potential energy is one of order and not of disorder. A crystal is more stable than a jumble of atoms. The perfect geometrical arrangement of a crystal represents matter in its most dead and inert form, from which nothing further in the way of change can be expected, just as the various Utopian schemes of society which have been put forward from time to time represent the most dull state in which it is possible to conceive living.

The world we are to study, then, is to be ruled by the laws of geometry. We will speak of tetrahedra, octahedra, angles, faces and edges. To appreciate this world, we must be like the Greek geometers, who were ravished by the beauty of the symmetrical solid figures. In no other science do these geometrical figures play so important a part; they are peculiar to crystallography. Though all crystals are based on geometrical patterns, the simplest regular geometrical forms are of outstanding importance in mineralogy just because minerals are so extremely inert. The condition for low potential energy imposes upon their configurations certain geometrical requirements, which are broken by the ephemeral compounds we prepare in the laboratory.

UNITS OF MINERAL PATTERN

Eight elements compose 98 per cent of the earth's solid crust. In our broad survey, we will neglect all the other elements, most of which only occur in odd cracks here or there where we laboriously search for them. The common elements are oxygen, silicon, aluminium, iron, calcium, potassium, sodium and magnesium.

The bulk of the crust is oxygen. Not only is it the commonest element, but also it takes up the most room. The rocks are made of oxygen atoms cemented together by silicon, aluminium and a few other elements. According to the way in which they build up structures with oxygen, these elements are divided into three classes, to which we will have frequent occasion to refer.

(*a*) Elements forming the centre of a *tetrahedral* group. Four oxygen atoms are grouped together at the corners of a tetrahedron, and the element is situated at the centre. All the silicon is in this situation, and by far the greater part of the aluminium.

(*b*) Elements forming the centre of an *octahedral* group. Six oxygen atoms are grouped at the corners of an octahedron, with the element at the centre. This is the characteristic situation for magnesium and iron, and also for the remainder of the aluminium. Aluminium is peculiar in that it can play a double rôle, generally grouping itself with silicon, but sometimes behaving like the metals iron and magnesium.

(*c*) The bulky elements sodium, calcium and

* From an evening discourse to the British Association delivered at Aberdeen on Sept. 10.

potassium. These elements are too large to be placed in tetrahedral or octahedral groups. They are accommodated in large, often unsymmetrical, holes in the structure.

The types of group are illustrated in Fig. 1. The tetrahedral and octahedral groups are the fundamental units of pattern—the stitches of which the mineral fabric is composed. All the common minerals, however complex their patterns, are a framework of these tetrahedral and octahedral groups. It must be realised that the groups are not distinct units, for there are not enough oxygens for each central atom to have its complete group belonging to it alone. The oxygen atoms of one group also form part of the next. It is very convenient to use the tetrahedra and octahedra in describing the structures, but it must be remembered that these units have common corners, edges, or even faces, because an oxygen atom of one also belongs to another. In this way the whole structure is knitted together.

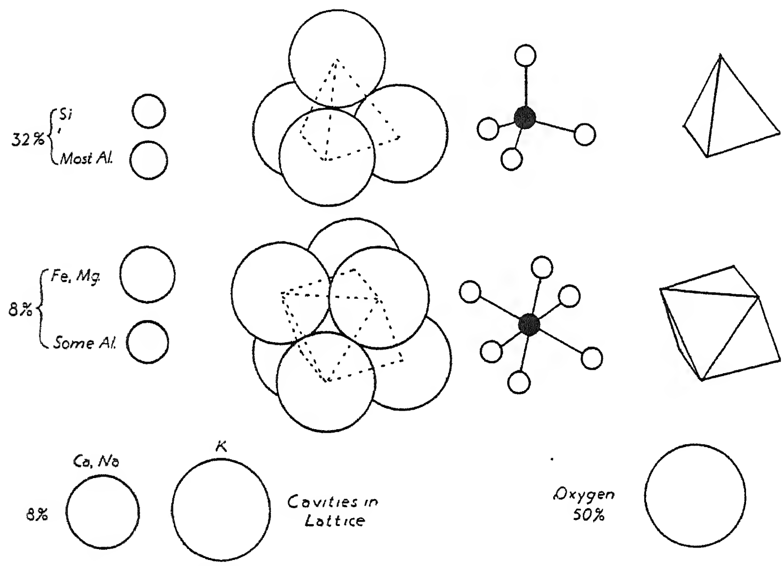

FIG. 1. Association of common elements with oxygen in mineral structures.

CLASSIFICATION OF MINERALS

The common minerals are divided into certain large groups, and in making his classification the mineralogist has in the past been guided by physical properties and form, rather than by chemical constitution. A study of the structure of minerals has amply justified this allegiance. It is now seen that the basis of the classification is a kind of skeleton of the mineral structure, composed of the linked tetrahedral groups. These links are stronger than the octahedral links, and very much stronger than the links of the bulky elements calcium, sodium and potassium. The tetrahedral framework is the hardest part of the mineral, its skeleton, and it has the chief influence in deciding the form of the structure.

The most common minerals are quartz, felspar, mica, pyroxenes and amphiboles. The basic ferromagnesian silicates such as olivine may also be included. These great natural divisions of minerals have strikingly different physical characteristics, and are built up as follows:

(*a*) *Olivine* $(Mg, Fe)SiO_4$. The SiO_4 tetrahedra are not linked directly to each other, only by intermediate octahedral groups round Mg or Fe. (Fig. 2*a*.)

(*b*) *Pyroxenes and Amphiboles.* $MgCa(SiO_3)_2$, $Mg_5Ca_2(Si_4O_{11})_2(OH)_2$. The tetrahedral groups are linked into endless chains by stringing them together corner to corner. These chains are held together sideways by magnesium and iron octahedra. (Fig. 2*b*.)

(*c*) *Micas.* $K(Al_2, Mg_3)(AlSi_3O_{10})(OH)_2$. The tetrahedral groups, containing both Si and Al, are linked into endless sheets. These sheets lie on each other like the leaves of a book, and are bound together in various ways. (Fig. 2*c*.)

(*d*) *Felspars.* $KAlSi_3O_8$, $NaAlSi_3O_8$, $CaAl_2Si_2O_8$. The tetrahedra form a framework in three dimensions, each tetrahedron being linked by every corner to another. The framework has the composition $(Al, Si)O_2$. The bulky ions K, Na, Ca are in open spaces within it. (Fig. 2*d*.)

(*e*) *Quartz.* SiO_2. This is a structure composed entirely of tetrahedra containing Si, linked everywhere corner to corner.

The type of structure corresponds to the composition of the mineral, in particular to the ratio of the first group of elements (those inside tetrahedra) to the available oxygen. For example, if there are four oxygens or more to every silicon, we have separate SiO_4 groups. If there are only two oxygens to every silicon, the tetrahedra must share *every* corner in order that each Si may have four oxygens around it, and the structure of quartz is the result. The intermediate types of linking represent intermediate ratios:

(*a*)	SiO_4	Separate SiO_4 groups	Olivine
(*b*)	SiO_3	Single chains	Pyroxenes
	Si_4O_{11}	Double chains	Amphiboles
(*c*)	$(Si,Al)_2O_5$	Sheets	Mica
(*d*)	$(Si, Al)O_2$	Networks	Felspar
(*e*)	SiO_2	Networks	Quartz

PROPERTIES AND STRUCTURE

We may now consider some properties conferred upon the minerals by these characteristic forms of grouping.

(*a*) *Olivine*.—In olivine the separate SiO_4 tetrahedra are linked together by Fe and Mg octahedra. It is geometrically possible to do this in an extremely compact way, without wasting any space. The mineral is also very uniform in texture, since there are no exceptionally strong bonds in one direction rather than another. Hence we have a heavy compact mineral of a glassy texture.

(*b*) *Pyroxenes and Amphiboles*.—These are composed of strings of tetrahedra, linked side by side by the Fe and Mg octahedra. As is to be expected, they are all fibrous in nature, splitting very easily along the chains but not across them. *Asbestos* is a well-known example of such a mineral. Asbestos fibres are most remarkable. One can tie an overhand knot in a fibre and pull it tight without breaking it, just as one can with a cotton thread. Familiarity lessens our surprise, but it is really extraordinary that a knot can be tied in a stone with such ease. This property arises from the very strong bonds along the chains of tetrahedral groups, and the relatively weak links which bind the chains together laterally.

These minerals are divided into two great classes, the pyroxenes and amphiboles. They are distinguished by their cleavage. The cleavages cross each other at about 90° in the pyroxenes, and 56° in the amphiboles. The reason for this difference was discovered by Warren. All pyroxenes are based on single chains of tetrahedra, all amphiboles on double chains, two chains being linked side by side to form a kind of tape. When we look at the chains end on, it will be seen that the amphibole chains have a much more oblong cross-section. The consequence is that the cleavage cracks, in avoiding cutting the chains, cross each other more obliquely in the amphiboles.

(*c*) *Mica*.—Sheets of mica cleave with extreme ease. A sheet can be split again and again into thinner lamellæ in an apparently endless way.

The structure of mica was first analysed by Pauling. The main feature is a series of sheets of tetrahedra, each tetrahedron being linked by three corners to neighbours to form a hexagonal network. Two such sheets are then linked together by Al, Mg, or Fe octahedra to form a composite sheet. It is these double sheets which are so immensely strong, and enable mica to be cleaved so easily, because each is only fastened to its neighbours on either side by the weak attractions of potassium atoms lying between them.

The perfection of the mica cleavage is a truly remarkable phenomenon. It runs along the plane where the potassium atoms are situated, and may run for a centimetre or more without deviating from this plane by a single atom. We can show this, as Friedel first pointed out, by growing crystals of ammonium iodide, $(NH_4)I$, on the mica. The ammonium atoms in this salt happen to have precisely the same arrangement as the potassium atoms in mica, both in shape and scale. In consequence, the crystals all grow in parallel orientation on the mica. The grain of the pattern in successive molecular sheets of mica points alternately to right and left of its symmetry plane, hence the little crystals of ammonium iodide also point to right or to left depending on which type of sheet forms the top surface of the mica. If

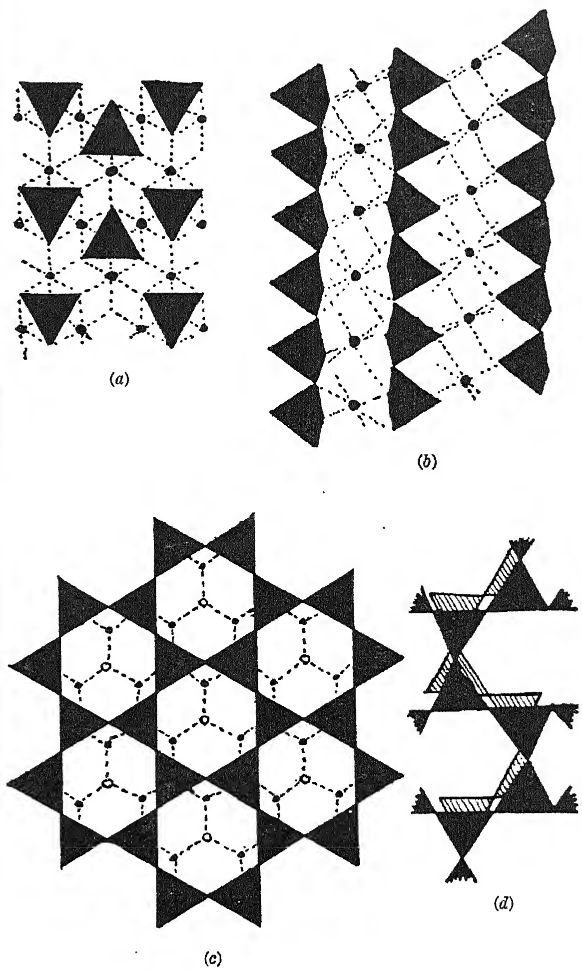

FIG. 2. The arrangement of the (Si, Al)–O tetrahedra in the common minerals. Tetrahedra are silhouetted in black. (*a*) Olivine, separate groups; (*b*) Pyroxene, chains; (*c*) Mica, sheets; (*d*) Felspar, three dimensional network.

they all point the same way, the top sheet must be the same all over the surface. Fig. 3 shows a mica surface in two steps, all the crystals pointing one way on one side and in the reverse direction on the other.

The 'grain' is less marked in micas (biotite, phlogopite) with the formula $K(Mg, Fe)_3(AlSi_3O_{10})(OH)_2$, than in micas (muscovite) with the formula $KAl_2(AlSi_3O_{10})(OH)_2$; hence in the former case the ammonium iodide crystals point indifferently in either direction.

The mica-like sheets form the basis also of the *clay* minerals. These are single sheets of tetrahedra with an active side of vertices and an inactive side of bases. The clay minerals are little hexagonal spangles, a kind of mineral 'leaf-mould'

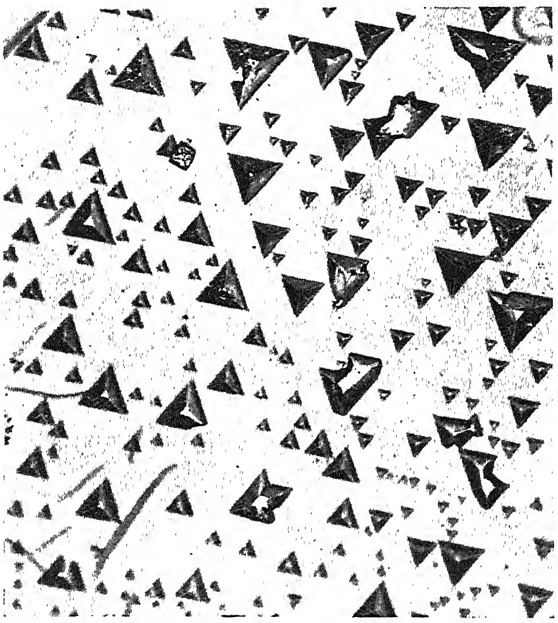

FIG. 3. The growth of ammonium iodide on mica (lepidolite). A sub-microscopic step on the mica sheet separates the two areas where the ammonium iodide crystals point in opposite directions. Each area is a true plane to within a single molecule. (× 80.) Photograph by Mr. C. W. Bunn, Imperial Chemical Industries, Research Laboratory, Northwich.

formed by the breakdown of other rocks. Their curious chemical and physical properties, so important to the soil, are the result of their platy character.

(*d*) *Felspar*.—This is the most important mineral of the earth's crust. We are familiar with it as a main constituent of granite. It is composed of Si and Al tetrahedra linked by every corner in every direction, a three-dimensioned latticework of tetrahedra. The bulky atoms Na, K, Ca are immeshed in its interstices.

We may only refer here to two of its interesting properties. In the first place, if we make a structure of tetrahedra linked by all their corners in this way, it is geometrically impossible to fit octahedra on to it. In consequence, magnesium and iron, which are characteristically in octahedral groups of oxygen atoms, are excluded from the felspar structures. We never find these metals in felspar.

In the second place, the felspars are divided into two great families. The more symmetrical orthoclase, $KAlSi_3O_8$, is typical of one family, and the less symmetrical albite and anorthite, $NaAlSi_3O_8$ and $CaAl_2Si_2O_8$, of the other. The difference is simply a question of the size of the large cation. Potassium is so large that when inserted into the framework it holds it distended into the symmetrical form, whereas the smaller sodium or calcium allow it to sag over into a lop-sided unsymmetrical shape. This explanation is due to Taylor, who first analysed the felspars.

DENSITIES OF MINERALS

Finally, I wish to refer to another broad feature of minerals, their *densities*. The densities again depend to a large extent upon considerations of geometry. If we pack isolated tetrahedra together with octahedra, as in olivine, space can be utilised in a most economic way. It is geometrically possible to arrange the structure so that a maximum number of oxygen atoms, with their concomitant cations, are included in a given volume. On the other hand, building up a structure by attaching tetrahedra corner to corner is most wasteful as regards volume. It produces an expanded structure containing large open spaces.

In consequence we find that olivine is the heaviest, and felspar and quartz are the lightest, of the common minerals, others being intermediate. The greater the extent of the tetrahedral linking, the lighter the structure, as the following list shows:

	Density.
Olivine	3·4
Pyroxene, amphibole	3·3–3·1
Mica	2·85
Quartz	2·65
Felspar	2·75–2·55

The fact is, of course, that the earth's crust is mostly composed of these minerals, with felspar and quartz predominant, just because they are the lightest and so float to the top. According to the scale of densities, the light felspars float on the heavier ferro-magnesian silicates, and these in turn probably on metallic sulphides and metals which are much denser. Geometry is again triumphant. The fortunate existence of a raft of rock on which life is possible is seen to be a result of the geometrical properties of tetrahedra and octahedra.

Science at the Universities*

By H. T. Tizard, C.B., F.R.S.

THE general growth in the teaching of science at secondary schools has naturally been accompanied by a great increase in the number of students of science at universities. There are now about 50,000 students in the universities of Great Britain, half of whom are studying some form of natural science. This growth has been made possible only by the provision of public money; all universities in Great Britain are now dependent on the taxpayer and ratepayer. The State alone provides annually for university education a sum nearly ten times as great as was provided before the War; and local government bodies, in addition to their direct contributions, find large sums for maintenance allowances to students. The student of science has to be provided with laboratories, where he consumes power, heat, light and expensive material. He is in consequence the most costly of university students: I estimate that the public expend, in one way or another, nearly £200 a year on each student of science, with the possible exception of students at Oxford and Cambridge, which are more richly endowed from private sources.

This public expenditure has laid additional responsibilities on the teaching and administrative staffs of universities. Most of us are now in the position of public trustees; we have to examine our expenditure more scrupulously than we should if we were not (indirectly) responsible to the public, and we have continually to ask ourselves whether additional expenditure can be justified.

There was a time when some universities were in the same happy position as the public schools. As self-supporting institutions they could go their own autocratic way, impervious to outside criticism. They took special measures to encourage the influx of students of outstanding ability; and as for the rest, the chief conditions of entry to a college were that they should be capable of paying highly for the privilege, and of passing a very elementary examination—often waived for men of noble birth or athletic renown.

The chief advantage of this complete independence was that it encouraged individuality in teachers and students; the chief disadvantage of the many reforms that have taken place since then, resulting finally in financial dependence, is that they tend to discourage individuality. Is any university school of physics or chemistry, for example, noticeably different from any other? In London we do our best to encourage individuality by having different final examinations for certain degrees in different colleges; at the Imperial College the B.Sc. degree of London is awarded on the results of college examinations in which outside examiners take part. The advantage of this is that it is not necessary to bring our syllabuses and methods of teaching exactly into line with those of other London colleges. There is, however, a strong, but fortunately not a majority, body of opinion in the University in favour of common examinations, chiefly on the grounds that they are easier and cheaper to organise. I hope it will be long before our measure of independence disappears. I would go so far as to say that individuality, which should be a natural growth in universities, needs to be deliberately encouraged in these days of committee rule. Any step taken to discourage it is a step downwards.

Oxford and Cambridge still have considerable freedom of action, partly because of their old traditions, but mainly, I think, because of the financial independence of the colleges. I do not know how far the ancient universities of Scotland preserve their own complete independence, but, in spite of apparent autonomy, the newer universities of England have not quite the same measure of freedom as Oxford and Cambridge. Their income can normally only just cover their expenditure, for if the margin were great, it would mean that they were receiving too much from the public. The close budgeting that is necessary inevitably restricts freedom of action. For example, if the number of students be reduced, the loss in fee income may convert a slight surplus into a deficit for some years, as it is impossible to reduce expenditure on staff and equipment correspondingly quickly. On the other hand, the immediate effect of increasing the number is to make the balance sheet look healthier: until a strong case can be made for more expenditure on staff and buildings, which eventually results in increased cost to the public.

It is unfortunate that there is quite a strong financial incentive to increase the number of students at universities; it looks so well on paper. Yet I feel that the time has come when we ought seriously to consider whether a further increase can really be justified. The public, I take it, is not interested in the individual; if the taxpayer thinks at all about his contribution to university education—and I do not suppose he does, as it is so trifling compared with other public calls upon his income—he must come to the conclusion that

* From the presidential address to Section L (Educational Science) of the British Association delivered at Aberdeen on Sept. 6.

the object of his contribution is to help students who will afterwards be of more value to the nation if they spend three or more years of a sheltered existence at a university, than if they were obliged to earn their living on leaving school. Where shall we draw the line ?

There are many students who occasion no misgiving. They are those who are capable of teaching themselves, given the opportunity. To them, and ideally to all, the attitude of the university should be this : We give you here the opportunity of learning, if you wish to, from masters of their subjects ; we give you access to well-equipped libraries and laboratories ; and opportunities for learning from each other. We help you to help yourselves. What use you make of these opportunities depends upon yourselves. If we find you do not, or cannot, make good use of them, you shall go, and make room for others. Broadly speaking, I believe that is the right attitude. In such an atmosphere, learning, individuality, and self-reliance flourish ; and public expenditure is worth while. Judged from this point of view, I have little hesitation in saying that universities are too full. As a result, the tendency is towards over-organisation, too little latitude, and too much spoon-feeding. The more distinguished the teacher, the more he is tempted away from teaching and research : his presence is required on committees. In London we elderly gentlemen even organise students' athletics ; and official debates take place on such important questions as the site and finance of a university boat club for women. The wider we fling open the doors to a university, the more will such organisation be necessary, and the worse will be the conditions for the best teachers and students.

There is another, more practical, way of looking at this question of numbers. Do graduates find any difficulty in getting suitable employment at the end of their university career ? Perhaps it is scarcely fair to attempt to draw a definite conclusion from experience during the last few years ; but it does form some guide to policy. The majority of students of the Imperial College enter some branch of industry ; and most of them, even in these difficult times, have succeeded in finding posts within six months of leaving the college. Whether they are all suitable posts for university graduates, I doubt ; many of them could equally well, and perhaps better, be filled by students from technical schools.

Different branches of industry seem to hold different views about the value of a university education in science. Compare, for example, the present position of the university chemist with that of the engineer. The chemical industry calls out for university graduates ; every year you will find leading representatives of the prominent firms in the universities, looking for recruits. It is not demanded of the recruit that he should possess a large stock of practical knowledge ; it is expected of him that he should have high scientific qualifications, and that he should have shown aptitude for independent work. The attitude of the engineering industry seems different. In some branches of the engineering industry the university graduate is as welcome as he is in most branches of the chemical industry ; but in many he seems to be regarded as a misfit. One prominent manufacturer, the creator of a great industry, who has lived most of his life near a university, has been known to boast that he employs no university graduates. Many employers seem to expect of an engineering graduate a degree of acquaintance with practice that they have no right to expect ; for we do not pretend to teach at universities what can be better learned at the works. Finally, my experience is that too many engineering graduates find themselves in blind alleys from which they have little opportunity to escape.

Where does the fault lie ? With the employers or with the universities ? I think there are faults on both sides : let me leave the faults of the employers for others to discuss, and for time to correct, and deal with some of the problems of university schools of engineering.

Engineering is a branch of technology. The object of a university school of technology is to seek to advance and apply scientific knowledge for practical purposes. Many people at universities still think there is something derogatory about this ; they would prefer that instruction and research had no relation to the practical needs of mankind, forgetting perhaps that most, if not all, university education started with a practical aim in view, or we should have had no schools of law or medicine.

Let me quote from the report of the University Grants Committee for 1921 :

"There is nothing in the nature of technology which makes it necessarily unsuited to the methods and spirit of university work. . . . The very fact that this alliance [between science and industry] is intimate, and the border line between pure and applied science difficult to define, involves serious difficulties for the universities. We cannot ignore a certain tendency to lay an exaggerated emphasis on utilitarian applications in some technological departments. . . . It would be in the worst interests of industry itself if the study of scientific problems were to be approached by the universities from the point of view of immediate material advantage. . . . We believe it to be urgently necessary, therefore, to define more closely the aim of university courses in engineering and technology, and to differentiate such courses from work properly assignable to technical colleges."

With these views and criticisms, I heartily agree: what is more to the point, perhaps, is that they have, I feel sure, the approval of many university professors of engineering, who would say that their aim is to teach principles, not practice; to train the mind without neglecting the training of the hand; and to send out ultimately from the university resourceful men whose education and outlook enable them to attack with confidence the new problems that are perpetually arising in the engineering world. A university school of engineering should be primarily a school of what is now called classical physics, the principles of which are illustrated in lecture room and laboratory by examples and problems which have a special bearing on engineering. To a less extent it should be a school of mathematics and chemistry. I think we are inclined, at universities, to value mathematical ability in an engineer too highly. Many students have obtained first-class engineering degrees mainly through their mathematical ability; but such students do not necessarily become first-class engineers, and some of the most original and distinguished engineers are poor mathematicians: one of whom I believe had to be content with a pass degree at his university.

I am inclined to think that there are too many students of engineering at universities. There are many young men who have a practical flair, but who cannot respond to the kind of teaching that I believe to be appropriate to the university. Their presence at the university, where everyone wishes to do their best for them, inevitably encourages the introduction of practical instruction of a kind more suited to technical schools. The university school is then trying to fulfil two functions, and runs the risk of failing to fulfil either well.

The same is true, I suggest, of other branches of technology. The chief aim of a university department of technology should be to produce the leaders of the profession. The best education for potential leaders is not the same as the best education for the rank and file. It cannot be expected that all university graduates will become leaders; but at least we ought to look for, and develop, the qualities of leadership. This we cannot do if we fall into the temptation of mass production.

Highly specialised schools of science at universities present somewhat different problems. How many students, for example, should one encourage to study subjects such as mining geology, biochemistry, plant biology, entomology, when the demand for such specialists may be small and fluctuating? Take the biological subjects as typical. Two years ago there was published the report of a strong committee appointed by the Government to advise on the education and supply of biologists. Their first two conclusions were:

(1) There is a substantial and growing demand from Government departments for biologists for service in Great Britain and in the colonies, and there is a small but probably growing demand for biologists from concerns engaged in agricultural production overseas and in industry in Great Britain.

(2) It is not possible to state this demand in precise arithmetical terms, but the supply of candidates for biological posts is not equal to the present demand, and even in those branches where the supply is sufficient in quantity it is deficient in quality.

Whatever evidence in support of these conclusions existed when the Committee started its inquiry in 1930, I think it safe to say that even before the report was published these conclusions were falsified by events. The fact is that some ten to fifteen years ago there was a sudden demand for biologists to meet the needs of new and of rapidly expanding research organisations at home and in other parts of the Empire. Highly trained biologists of all kinds were sought for, and naturally could not be found in sufficient numbers, for universities cannot suddenly increase the rate of production of first-class specialists. Some of the new organisations made the mistake, therefore, of accepting less able and less highly trained men, which is bad for the individuals concerned and for the organisations; for, if a first-class man is really needed, it is better to wait until one is available than to make shift with a second-class man, who runs the serious risk of having his livelihood taken away from him later on.

Then came the world depression, and far from there being an increased demand for 'industrial' biologists in recent years, there has been a contraction. This is a serious state of affairs for universities. It would be a fatal policy to encourage young men of good ability to spend long years in specialised study, only to find at the end that there was no demand for their services, or that what little demand there was offered inadequate prospects for the future. It is a far better policy deliberately to keep the supply somewhat short of the demand; the world will not appreciably suffer if any particular application of science to industry and agriculture develops rather more slowly than the enthusiast could wish, and there are few spectacles more distressing than that of the highly educated specialist who is unemployed through no fault of his own, and whose training and interests do not fit him for other work. The lessons of the last few years teach us that public statements about the shortage

of specialists in any branch of science and technology are apt to have an unfortunate effect in schools and universities; for they may be out of date before a normal period of advanced training is finished.

It is of interest to examine a little further the Committee's belief that the supply of biologists at universities is lacking in quality as well as in quantity, which they attribute to the neglect of biology as a subject of study in schools. While sympathising with their views, which are shared by many people, I think it cannot be denied that whereas a biologist must have an adequate knowledge of physics and chemistry, it is not necessary for a physicist or chemist to have a knowledge of biology; and if one considers the position from a cultural rather than from a practical point of view, it would be fair to say that the boys who need least to study biology as a cultural subject at schools are those who are going to study it at a university. The only point that remains, then, is that if biology were taught more widely in schools, it is possible that here and there a boy "may experience from biology a pull which he had hitherto failed to secure from his special subject".

For my part, I feel confident that directly there is an assurance of reasonable careers in biology, suitable candidates will be forthcoming, and education at schools and in the universities will develop on sound lines. Lack of teaching of biology at schools has not led to a shortage of doctors. How, then, can it be mainly responsible for a shortage of other biologists? It needs no inspired prophet to foresee a great development some day of the biological sciences: the work of pioneers to-day makes that sufficiently obvious. The next generation may live to see a development comparable with that of the physical sciences, and their applications, in the last thirty years; but the time is not yet ripe. Until it is, our duty at universities is to keep our biological departments moderate in size, but high in quality.

These practical considerations are not exhaustive and do not lead to any definite conclusion on the problem of the size of university departments of science and technology. In the end, the optimum size is a matter of judgment; my judgment, for what it is worth, is that on the whole there is no strong case for increasing the numbers of students of science and technology at universities. In thirty years' time, this statement may look ridiculous, but one cannot foresee events so far ahead. Rather than any marked expansion in numbers should take place during the next five years, I should prefer to concentrate on giving the better man a better chance than he has now; to improve the quality rather than to increase the quantity.

Obituary

PROF. W. M. HICKS, F.R.S.

BY the death of William Mitchinson Hicks on August 17, the world of science has lost an outstanding figure, whose achievements were perhaps more appreciated by the last than by the present generation. Born at Launceston on September 23, 1850, he went up to Cambridge in 1870 as a scholar of St. John's College, and reached the position of seventh wrangler in the Mathematical Tripos of 1873. This was the year in which the Cavendish Laboratory was founded with Clerk Maxwell as first professor, and Hicks formed one of the small band of distinguished students of experimental physics who gathered round him, and came directly under his inspiration. In 1876 he was elected a fellow of St. John's, and lived there until 1883, engaged in the earlier stages of his mathematical researches on the theory of vortex rings. In that year he was appointed principal and professor of physics and mathematics in the Firth College at Sheffield, and from this time onward his energy was devoted to the furtherance of university education in that town.

This tiny College—the staff numbered only half a dozen all told—had developed, as in other towns, out of the zeal for higher education marking the earlier days of the century, which was shown in this instance by a bequest of Mr. Mark Firth. It carried on a struggling and precarious existence, but its subsequent history forms a monument to the vision and untiring work of Dr. Hicks.

The first stage of Dr. Hicks's ideal was the union of the Firth College, the Technical School, and the Sheffield School of Medicine into one university college, which he succeeded in accomplishing in 1897. The opportunity for further development, apart from the foundation of new departments, came in 1903, when the Victoria University formed by the Liverpool, Manchester, and Leeds Colleges was dissolved. It was clear that the system of constituting a university by the federation of several distant university colleges was too cumbersome to work, and each town set about providing its own. The opportunity was seized in Sheffield also—it was now or never, and a large sum would have to be raised. Dr. Hicks's quiet but persistent pressing forward of his ideals, his scientific eminence and his obvious single-mindedness and sincerity, convinced the important persons of the city, and ultimately gave rise to a wave of popular enthusiasm which brought the necessary endowment in its train. He was a man content with doing his good work for the founding of the University, and courted no popular recognition,

but those who knew the circumstances know well that his was the vision, and to him the accomplishment of it was largely due. On its constitution in 1905, the University appointed him as its first Vice-Chancellor, but he only held the office for a few months. His bent had always been for research, and he was anxious to get back to it, so that as soon as possible he withdrew from the vice-chancellorship to become simply the professor of physics, with comparative leisure for his research work. However, in 1913 he acted as Vice-Chancellor again for a year, stepping into the breach in an emergency.

Hicks's scientific work falls naturally into two parts separated in time by the year 1909. Up to this date, much of it can be summed up by the words 'vortex rings'. After the discovery by Sir William Thomson of the permanence of a vortex ring in a frictionless fluid, this subject made a double appeal to the younger school of mathematical physicists in Cambridge. In the first place, the mathematical difficulties of further treatment presented a continual challenge to their ability, and in addition there was the definite hope, in those classical days, of developing from it a theory of the real atom. Hicks made the subject peculiarly his own, inventing the necessary 'toroidal' functions for the treatment, and in a series of four brilliant memoirs in the *Philosophical Transactions* worked out the properties of vortex rings exhaustively. Among his discoveries was that of the existence of vortex aggregates, which showed a remarkable analogy with the periodic constitution of the elements. His eminence in these researches was marked by the award in 1885 of the Hopkins Prize in Cambridge, and by his election to the Royal Society in the same year. Later he was awarded the Royal Medal of the Society, and he served on the Council for many years.

From 1909, not only to his retirement in 1917 from his chair of physics, but also to the very end of his life, Dr. Hicks devoted himself to the task of elucidating the structure of spectra. Greatly attracted by Rydberg's memoir on the relationships between series lines, and imbued with a profound admiration for Rydberg's work, he set about extending it. The basic idea was to try to find out as much as possible about the relations between the frequencies of lines apart from all questions of theory. In its spectrum, each element wrote its signature, but in cypher form, and the methods he proposed to adopt were purely those appropriate to finding the key of the cypher. The difficult mathematics of his earlier works was replaced almost wholly by numerical calculations, simple individually, but laborious in the immense number of them. The results are presented in numerous papers in the *Philosophical Transactions* and the *Philosophical Magazine*. His essay on the "Analysis of Spectra" was awarded the Adams Prize in 1921, and a full account of his work up to then, based on the essay, was published in 1922. The results of his later work are to be published this autumn in a book on the "Structure of Spectral Series", on the proofs of which he was working when he collapsed with the illness which in a few weeks ended his life.

It is difficult at the present time to estimate justly the value of Hicks's results in this field. They tend to be neglected by modern spectroscopists, because admittedly in a certain proportion chance agreements occur in the applications of the rules he has discovered, and it is difficult without great labour to determine to what extent the validity of the rules may be affected thereby. But another reason is that no one can find any way of fitting them into the present day theories of the emission of light. Hicks recognised both these difficulties, but believed that his results must be held available, perhaps for a later generation of spectroscopists to succeed in fitting them into a framework of theory.

Dr. Hicks had two sons, one of whom was killed in 1915 in the War; his memory is perpetuated by the Basil Hicks lectureship, which provides for a series of public lectures at the University of Sheffield by eminent men on subjects connected with the War and international peace. Not very long after his retirement from the chair of physics at Sheffield, Dr. Hicks's wife died, and in 1919 he went to reside in the little country village of Crowhurst in Sussex, and remained there until his death. He was a man of vigorous constitution, extremely fond of walking, and a great lover of Nature. He explored the countryside for miles round his home, and many villagers must now miss his genial presence. Hampered somewhat by increasing deafness in his later years, he lived an extremely regularly ordered life, working with amazing industry at his calculations every morning, and walking in the afternoon. Nothing gave him greater pleasure than to be visited by his friends and old students, for whom he had a warm affection. The simplicity and courtesy of his mind and manners, his thoughtfulness for others, and the selflessness of his devotion to truth, mark him as a noble, not merely an eminent, man. The memory of him as such will be cherished by his friends as long as they live, while his scientific work on one hand, and the University of Sheffield on the other, form enduring monuments to his fame. S. R. M.

THE death is announced of Dr. Maurice Fishberg, the anthropologist, which took place suddenly at the age of sixty-two years in New York on August 31. Dr. Fishberg was born in Russia, but educated in New York, where he studied medicine. He also devoted special attention to the study of anthropology and questions of race, and came to be recognised as the foremost authority on the physical anthropology of the Jews. He was the author of "Physical Anthropology of the Jews", "Comparative Pathology of the Jews" and a volume "The Jews" which appeared in the Contemporary Science Series. His views on the origin of the differences in physical character displayed by the Jewish people in varying environments have been more widely accepted among non-Jewish anthropologists than they have among those of his own people, who have stressed the unity and continuity in history of the Jewish people as a race of distinctive character and culture.

News and Views

Sir Richard Glazebrook, K.C.B., F.R.S.,

SIR RICHARD GLAZEBROOK reaches his eightieth birthday on September 18, and there must be few men in this or any other generation whose names are associated with such a long career devoted unremittingly to the services of science and the State. "Ease, from this noble miser of his time, no moment seeks" and first as fellow, tutor and bursar of Trinity College, Cambridge, then as principal of University College, Liverpool, and afterwards as first director of the National Physical Laboratory, Sir Richard has never wearied in well doing, and has ever brought a single-minded resolution to bear in turn on each of the many problems which came to hand. Of the breadth and diversity of his activities there is no room to speak here—the Universities Commission, the Museums Commission, the 1851 Commission, the Aeronautical Research Committee, the "Dictionary of Applied Physics", the Gas Referees, the presidencies of many institutions and societies—he has always revelled in work and thrived on it. As chairman of countless committees, he is not likely to be surpassed for his ability to crystallise discussion into decision and decision into action. But the biggest debt of all which the Nation owes him, and for which he will always be remembered, is for the skill, resource, pertinacity and judgment he brought to bear in creating and moulding the laboratories at Teddington into a great national institution with a standing unquestioned, both at home and abroad. It is a privilege to be able to extend our congratulations to Sir Richard on a great occasion, and to wish him many more years of untiring service.

Prof. W. W. Watts, F.R.S.: President-Elect of the British Association

No man of his generation has exercised greater or more knowledgeable influence on geologists and the progress of British geology than Prof. William Whitehead Watts, president-elect of the British Association for 1935. Born at Broseley in Shropshire in 1860, he was educated first at local schools and then at Denstone College, Staffordshire, and Sidney Sussex College, Cambridge. His teaching career was started when he undertook university extension lecturing and for a time took charge of the Department of Geology at Leeds. It was continued when, after some years of service as petrologist on H.M. Geological Survey, he became deputy professor of geology at Oxford. It was as professor of geography and assistant professor with Charles Lapworth at Birmingham that he made his mark, and by that time he had produced his "Geology for Beginners", a small book which for forty years has provided the first introduction of the science to young geologists in all the English-speaking world. In 1906, Watts succeeded Judd as professor of geology at the Royal College of Science and the Royal School of Mines, London, where he has built up a school, the students from which have filled academic professorships, directorships of geological surveys and many and diverse posts of influence in industry in many lands. Since the Imperial College was instituted in 1908, the Department of Geology has been extended by Watts's organisation of the Sub-Departments of Oil Technology and Mining.

PROF. WATTS's talent for administration has led him to respond to insistent demands for his services outside the Imperial College, and he has held office as dean of the Faculty of Science and member of the Senate of the University of London, secretary and president of the Geological Society of London, president of the London Geologists' Association, president of the Mineralogical Society and secretary of the Conjoint Board of Scientific Societies and Technological Institutions. Notwithstanding the time taken up by teaching and administration, Prof. Watts's own researches—more especially those concerned with Charnwood Forest and in Shropshire—have proved an inspiration to all British workers concerned with Lower Palæozoic rocks. His interest in the applications of science led him to choose for his presidential address to the Geological Society in 1911 the problem of the hidden coal resources of Great Britain, a conspectus remarkable for its breadth of view. Prof. Watts's connexion with the British Association dates back to 1883, and since that time he has been associated as secretary and chairman with the still active Committee on Geological Photographs, the oldest of the Association's research committees extant and the only one which has been self-supporting since its inception. He has been in turn secretary, recorder and, at Southport and again at Toronto, president of Section C (Geology). Among the honours which have been conferred upon him are the Wollaston and Murchison Medals of the Geological Society, honorary doctorates of the Universities of St. Andrews and Edinburgh and the honorary fellowship of Sidney Sussex College, Cambridge.

British Association at Aberdeen

IMMEDIATELY before the delivery of his presidential address at the inaugural meeting of the British Association, Sir James Jeans announced that the following message had been sent to H.M. the King: "Your Majesty,—We, the Members of the British Association for the Advancement of Science assembled in the City of Aberdeen in annual session, desire humbly to recall to Your Majesty that it was in this City that His Royal Highness The Prince Consort assumed the Presidency of the Association in the year 1859. From the Presidential Chair, he conveyed to the assembled members of the Association a gracious message from Her Majesty Queen Victoria, and delivered an Address which disclosed his own profound interest in the advancement of Science. The many marks of Royal favour which have been extended to our Association on subsequent occasions have provided further signal encouragement to us in

our pursuit of the aims defined by His Royal Highness, and on all these counts we now desire to express to Your Majesty our humble gratitude. J. H. Jeans, President." The following reply was received from Sir Clive Wigram: "I am commanded by the King to thank the members of the British Association for the Advancement of Science for the loyal message which they have addressed to His Majesty, their Patron, from the Inaugural General Meeting in the Ancient City of Aberdeen. His Majesty appreciates their kind remembrance of the occasion when the Prince Consort, as President of the Association, delivered a message from Queen Victoria to the members assembled in this City three quarters of a century ago. The King desires me to assure the members of his unabated interest in their Meetings and his confidence that their investigations into the manifold problems confronting present day Scientists will continue to be productive of results which will benefit mankind. Clive Wigram."

THE report of the Council of the British Association, adopted by the General Committee at Aberdeen on September 5, records that the Local Committee for the Leicester meeting has presented the sum of £1,000 to the Association, being the unexpended balance of the fund raised locally for the purposes of the meeting. This gift has been gratefully accepted, and the sum will be invested to form a Leicester and Leicestershire Fund, the interest of which will be used "to assist by scholarship or otherwise a student or students working for the advancement of science". Five new members of Council were elected by the General Committee, namely, Sir T. Hudson Beare, Prof. A. V. Hill, Dr. W. W. Vaughan, Dr. W. T. Calman and Prof. H. M. Hallsworth. Future meetings of the Association will be at Norwich, 1935 (September 4–11); Blackpool, 1936; Nottingham, 1937; Cambridge, 1938; Dundee, 1939 or 1940. Sir Josiah Stamp announced at the conclusion of the inaugural meeting at Aberdeen that the membership for the meeting had reached a total of 2,784.

Causation of Cancer

IN a paper published in *Medizinische Welt* of August 25, Dr. W. von Brehmer claims to have obtained in pure culture an organism, present in the blood of cancerous patients and of animals bearing tumours. The organism could also be obtained from human and animal tumours. It is a pleomorphic aerobe which in pure culture appears in the form of tubules $0\cdot5\,\mu$–$2\cdot8\,\mu$ long and $0\cdot2\,\mu$–$0\cdot8\,\mu$ broad, and can be stained by a Giemsa stain. The tubules are filled with spores, which when liberated, are stated to be able to enter damaged cells and thus cause cancer. An essential condition for obtaining cultures of this organism, to which the name *Syphonospora polymorpha* has been given, is an alkaline condition of the medium, with a *p*H of 7·5–7·6, and von Brehmer maintains that cancer is always associated with a shift of the hydrogen ion concentration of the blood toward the alkaline side. The organism is stated to exist in the blood of apparently normal healthy people in the form of small spores which are non-pathogenic, but become pathogenic with the shift of the hydrogen ion concentration. Dr. von Brehmer also claims to have produced tumours in animals by the injection of pure cultures of his organism, but no detailed evidence is given.

DR. VON BREHMER's paper is followed by a paper by V. Schilling, who has repeated these experiments, partly with von Brehmer's assistance. He has succeeded in obtaining pure cultures of this organism from malignant tissues and from the blood of cancer patients and of animals bearing tumours. His experiments on the production of cancer in animals by inoculation of these tumours have, however, given negative results. He is, therefore, inclined to regard the presence of this organism as being due to a mixed infection or to its being a non-pathogenic symbiont, and he dissociates himself from the therapeutic and diagnostic conclusions drawn by von Brehmer from his work. The existence of a relatively large, visible and stainable organism as the cause of cancer is difficult to reconcile with many of the well-established facts concerning cancer. Moreover, the existence of an alkalosis in cancer, which von Brehmer considers to be an essential feature of cancer, is questionable and several competent observers using exact methods have failed to demonstrate it. It has been reported (*Times*, September 10) that von Brehmer's claims will be submitted to an official investigation, initiated by the authorities in Germany. Until the results are known, it is necessary to reserve judgement.

Food Storage and Transport

ON September 7, Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, delivered the Hardy Memorial Lecture before the British Association at Aberdeen, in which he paid tribute to the work of the late Sir William Hardy, who during the last seventeen years of his life, devoted much of his time to research on the transport and storage of foodstuffs. Sir Frank described the work being done on the kippered herring at the Torry Research Station, Aberdeen, which was founded by Sir William Hardy. A new kippering kiln has been evolved there, in which all variables such as temperature, humidity, etc., can be controlled. Thus, any desired cure can be produced with certainty. At the same station, a new kind of mild salted herring has been produced by the combined processes of salting and chilling. About 1,600 steam trawlers fish from the ports of Great Britain, landing nearly 700,000 tons of white fish valued at about 12½ million sterling each year. Storage in crushed ice, under conditions prevailing when Hardy took up the problem in 1929, could only hold such fish fresh for 6–7 days. To-day, work at the Torry Station has extended that period to 12 days, by reducing bacterial contamination. Further work has shown that freezing in brine at $-20°$ C. and storing at the same temperature will keep the fish for three months. The 10,000-ton vessel *Arctic Queen*, fitted as a floating factory for halibut, was also described. The importance of refrigeration cannot be over-

emphasised in connexion with food storage and transport. Sir William Hardy's fruitful work along these lines was fittingly described by Sir Frank. Thanks largely to the work of Sir William, it is realised to-day that the biologist must formulate the condition required in food storage and transport, and the engineer provide those conditions. The problems of the biologist concern not only methods of refrigeration itself, but also cleanliness, damage to foods by cold, etc. The most recent developments in gas storage using carbon dioxide, and in the storage of living material such as fruit, were also discussed by Sir Frank.

Cleansing of Oysters

THE cleansing of oysters on a commercial scale has now been accomplished after a period of some fifteen years' continuous research work at the Conway Experimental Station of the Ministry of Agriculture and Fisheries. A purification station has been established at Brightlingsea, and since May has produced 'certified' American and Portuguese oysters. The principles of the process are almost the same as those involved in the cleansing of mussels, namely, a thorough preliminary cleansing of the outside of the shell is followed by a first and then a second bath in sterilised water. During immersion in the baths the oysters cleanse themselves internally and externally (that is, the external soft parts inside the shell) of bacteria in a simple way; the internal bacteria are expelled from the gut in the fæces, the external in mucoid films which are gleaned from all parts by cilia to be collected and extruded in masses as pseudo-fæces. After each bath, the shells are thoroughly washed to remove the excreta and are finally treated with water containing three parts in a million of free chlorine to destroy any remaining adherent germs. An essential feature of the oyster-cleansing process consists in the use of water at a temperature not less than 56° F., as it was found after a long series of experiments that ciliary activity below this temperature could not be relied upon to effect perfect cleansing. Mussels can be reliably purified in water which does not fall below 39° F. The English native (or European) oyster (*Ostrea edulis*) has been purified in a process involving three baths, and differs otherwise in its reactions from the American and Portuguese. It is reported that purified *O. edulis* may be produced in the coming winter. The summer capacity of the tanks is 360,000 oysters per week, but in winter when the sea-water requires to be warmed, the capacity is halved. Full details of the process and the plant are not yet available, but may be published in the near future.

The Droitwich Broadcasting Station

IN the presence of representatives of the Press, the new B.B.C. transmitting station at Droitwich was formally opened on September 6, to take over a part of the National broadcasting programme. This station will ultimately provide a full national programme from the long-wave transmitter which is now working, and also a regional service for the Midlands from a medium wave transmitter which will be completed in about six months' time. The programme transmitted from the new station on the opening day was heard in London very clearly, and its volume was considerably greater than that of the London National transmitter at Brookman's Park. It is expected that the new long-wave station will give a service of such quality over so large an area of Great Britain that three other national stations—those for London, the West and the North—will not need to go on broadcasting. The wave-lengths thus released may be used for other British stations to be erected in the future. The wave-length of the new Droitwich transmitter is identical with the long-wave Daventry station so that no change is required in listener's receiving sets.

THE issue of *World Radio* of September 7 contains an illustrated technical description of the new transmitting station at Droitwich, by Mr. Noel Ashbridge, chief engineer of the B.B.C. This transmitter has an aerial input power of 150 kw., five times as great as that of Daventry. The whole of the power for the station is generated by heavy oil engines, and these prime movers together with the electrical machines and their control equipment occupy a considerable proportion of the space in the station buildings. The long-wave wireless transmitter consists of five units, by means of which, weak oscillations of a carefully controlled radio frequency are amplified up to a final output power of 150 kw. Modulation is carried out at the penultimate stage by varying the high-tension supply to the anodes of the high-frequency valves, with which the modulating valves are in series. This method of modulation, together with a special output circuit arrangement, makes it possible for this transmitter to emit broadcasting programmes of a much superior quality to that hitherto possible from a long-wave station. The quality of the transmissions from Droitwich is expected to be at least equal to, and probably better than, those at present obtainable from the medium-wave stations. The new station is now radiating the morning National programme from 10.15 A.M. until 11.55 A.M. and the late dance music every week-day; it will continue to do this until it takes over the full service of the National programme from Daventry in October.

Edinburgh Geological Society Centenary

THE centenary of the Edinburgh Geological Society was celebrated on Monday and Tuesday, September 3 and 4. A considerable number of invitations had been sent out to kindred societies and institutions both at home and abroad, and a most gratifying response was received. On Monday morning the delegates were received by the president of the Society, Sir John Flett. Naturally the majority came from Scotland and England, but out of a total of sixty visitors, thirteen came from the Continent, nine represented the Colonial Empire, and four the United States of America. Following this reception, the whole party, including many fellows of the Society, had lunch in the city and proceeded to visit the Royal Scottish Museum, where the various exhibits were demon-

strated by the Museum staff. Afterwards a visit was paid to the offices of the Scottish branch of H.M. Geological Survey. Here all branches of the work were illustrated by carefully prepared exhibits including photographs, maps, rock collections and models. On Monday evening the fellows of the Society and the delegates were received by the Lord Provost and Town Council of the city. Tuesday's programme opened in the Geology Department of the University with a welcome by the principal, Sir Thomas Holland, who gave an address on the position of geology at the time the Society was founded. This was followed by addresses by Prof. F. D. Adams of Montreal, who dealt with the beginnings of Canadian geological survey. Prof. C. F. Kolderup, of Bergen, compared the geology of Norway with that of Scotland, and Prof. Baron de Geer gave an interesting summary of the work on varve-clays and their possible use in correlating glacial deposits throughout the world. Prof. W. N. Benson, of New Zealand, described the work of Sir James Hector, who was a graduate of the University of Edinburgh and a member of the Society and initiated the geological survey of New Zealand. The afternoon was devoted to a tour of places of geological interest within the city. The celebrations were brought to a close on Tuesday evening when the Society entertained its delegates to a dinner.

International Scientific Radio Union

A PLENARY congress of the International Scientific Radio Union (Union Radio Scientifique Internationale) is being held in London on September 11–19. The "U.R.S.I." is one of the constituent bodies of the International Council of Scientific Unions, and its secretariat is conducted by Dr. R. B. Goldschmidt in Brussels. This is the first occasion on which the Union has met in London, and representatives of some twelve or more nations are in attendance. The Congress is being held in the rooms of the Royal Society, Burlington House, with Dr. W. H. Eccles acting for the president of the Union, Prof. A. E. Kennelly, who is unfortunately prevented by ill-health from making the journey from the United States. The British National Committee of the U.R.S.I. is led by its president, Prof. E. V. Appleton, with Prof. S. Chapman as secretary and Dr. E. H. Rayner as president of the reception committee. The work of the assembly is divided among five commissions dealing respectively with radio measurements and standards, the propagation of waves, atmospherics, liaison, and radio physics. Subcommissions have been appointed to deal with the detail work on the agenda falling under these subjects. The London meeting includes certain technical visits and other appropriate engagements of interest to the delegates from other countries.

Prehistoric Shetland

A REMARKABLE view of the life and culture of settlements of prehistoric and Viking times is given in the results of excavations, which have now been carried on for four seasons, at a promontory in the inlet of Sumburgh Voe at the southern extremity of the Shetlands, by Mr. A. O. Curle under the Office of Works. The site was first brought to light about thirty years ago, when, as the result of a storm, a brock and subsidiary buildings, of which the occupation probably extended into the Christian era, were found on the foreshore. According to an account of the present season's excavations in the *Times* of September 10, several dwelling-places have been explored, some belonging to the prehistoric settlement, others to the Viking settlement, which is dated at the tenth to twelfth centuries. The prehistoric inhabitants were a simple pastoral people, of stone age culture, whose pottery suggests the Iron, rather than the Bronze, Age. In the oldest of the dwellings as yet examined, there are three phases of occupation and, in the third of these, moulds for bronze weapons and implements appear. In the later occupation of the site, bronze gives way to iron, while the earlier simple unornamented pottery with a plain rounded rim is replaced by pots with the deep hollowed rim characteristic of the Continental Hallstat culture. Towards the close of the Bronze Age, souterrains were in use, of which three have been found. Cattle were housed in the dwelling-place, and the people lived in small lateral chambers. In front of one of these was a quern, while four steatite vessels stood on a bench in front of another. One Viking house, which has been excavated, gives a remarkably complete view of the internal arrangements and method of roofing of the structure. Among numerous Viking relics the most noteworthy is a series of engraved slates, on one of which is a sketch of a Viking galley, singularly detailed within the limitations of the technique.

Anthropology and the African

THE presidential address to the Royal Anthropological Institute delivered by the Rev. E. W. Smith (*J. R. Anthrop. Inst.*, **64**, Pt. 1) is noteworthy as a carefully balanced survey of the arguments which have been advanced for and against anthropological studies as a factor in the future development of the African, by one who has had a prolonged experience of the practical problems which arise in close intercourse with the less-advanced peoples of the continent. While pointing to the advances which have been made in the practical application of anthropological principles and knowledge of anthropological data in the problems of administration, he also stressed the fact that the 'open door' is by no means entirely won. In dealing with criticism of missionaries and the criticism of anthropologists by missionaries, his views as a member of both bodies should do much to remove a general misapprehension as to the relation of the two systems, which, as he showed, are by no means incompatible in practice. For while he admitted that in earlier days missionaries had tended to introduce into missionary teaching much which belonged to Western civilisation rather than to Christianity, a new body of missionaries is growing up whose work is carried on in a spirit analogous to that of the administration under 'indirect rule' by the effort to build on African institutions and sentiment, preserving what is good

in it, rather than destroying it entirely, as too often was the endeavour of earlier generations. It has been noted recently that a feeling of disillusion and pessimism is appearing among Africans; but Mr. Smith looks to win the co-operation of the African in his own development, and in this connexion regards hopefully the interest he is beginning to take in the systematic study of his culture and institutions.

Training for Management

DURING recent years, considerable interest has developed in the possibilities of specialised training for business management. Such training, it is recognised, is not a substitute for experience but a supplement, or rather a preparatory basis, which provides a broader foundation on which experience can build. The applications of science to industry, intensified world competition, the increasing complexity of industrial organisation and other factors have combined to make the task of successful management far more complicated and difficult than it was in the past. To provide for the systematic training of men for responsible posts in business, a Department of Business Administration was established at the London School of Economics in 1930 through the joint efforts of leading business firms and the authorities of the School. Selected students are given full-time training in the broad principles of business administration, and throughout the course efforts are made to keep the teaching in close touch with reality through discussions opened by business men and by visits to factories, shops and offices. Special attention is paid to marketing, retail management and sales management, and instruction in these subjects is based on fresh investigations into current practice. The recently issued prospectus of the Department for the coming session shows that during the past three years nearly fifty students have passed through it, most of them university graduates. Last summer, the Department began an experiment in training which was designed to be of practical help in bridging the gap between university study and entry into business. Under this scheme, which is being extended during the coming session, a number of firms offer appointments to university graduates of high standing who are selected by them and approved by the Department on condition that they attend the specialised business course during the academic year from October until June.

A MANAGEMENT course for industry and commerce, which covers departmental functions, methods, problems, underlying sciences and managerial mental activity is being given by Mr. W. R. Dunlop, 57 Gordon Square, London, W.C.1. Mr. Dunlop offers a complete outline of knowledge relevant to the management and direction of an organisation departmentally and as a whole. There is also a personal side devoted to individual difficulties and requirements. The course is useful, not only to those who manage or who expect to, but also to professional and technical experts from the point of view of co-operative efficiency, and has been taken, either orally or by correspondence, by experienced accountants, managers, industrial chemists and engineers in some of the largest industrial concerns. Critically selected references for reading are included. The course, which is personal and private, has its advisory professional practitioners from whom expert information and advice can be obtained when required, thereby combining the chief advantage of institutional instruction with private tuition.

Medieval Spices

COMMENTING on a suggestion in a recent review of a leechbook in NATURE (**134**, 270, Aug. 25, 1934) that certain spices "must have been hard to come by in fifteenth century England", Mr. G. M. Meyer, of 38 Manor Park Gardens, Edgware, points out that ginger and pepper must have been usual articles of commerce in the years 1300–1, and presumably in later years, since they were then the subject of specified King's dues and of authorised brokerage charges at the port of Sandwich. The mere fact that a commodity is imported into a country does not necessarily imply that it is not difficult to obtain, at any rate by those not blessed with wealth and influence. The interesting historical account of pepper given by Fluckiger and Hanbury ("Pharmacographia"; London, Macmillan and Co., 1879) shows that it was only after the Portuguese, incited in part thereto by the high price of pepper, had discovered a sea-passage to India in 1498, that the cost of this condiment began to fall, and the following quotations from these authors seem to indicate that pepper was usually too uncertain in supply and too expensive to be regularly obtainable, except by the wealthy. "The price of pepper during the middle ages was always exorbitantly high, for the rulers of Egypt extorted a large revenue from all those who were engaged in the trade in it and other spices. The general prevalence during the middle ages of pepper-rents, which consisted in an obligation imposed upon a tenant to supply his lord with a certain quantity of pepper, generally a pound, at stated times, shows how acceptable was this favourite condiment and how great the desire of the wealthier classes to secure a supply of it when the market was not always certain." Ginger was apparently not so commonly a subject of comment and controversy in medieval times as pepper, but it is on record that during the thirteenth and fourteenth centuries a pound of ginger cost about the price of a sheep.

British Association Mathematical Tables

THE issue of NATURE of March 17 gave a historical account of the British Association's work since 1888 in the calculation of Bessel functions and of the financial difficulties which have impeded publication. It was pointed out that unless funds were provided, there was a danger that all this labour would result merely in a manuscript locked up in a fireproof safe. We are glad to hear that the appeal for funds has been successful; the British Association has contributed £100 and the Royal Society £50, and the publication of the tables is now assured. They will form vols. 6 and 7 of the Association's collection. The first three volumes have already been noticed

in this journal. Vol. 4, "Cycles of Reduced Ideals in Quadratic Fields", prepared by Dr. E. L. Ince, was published in August, and vol. 5, containing the prime factors of all numbers from 1 to 100,000, is now in the press, and it should be available before the end of the year. This valuable set of tables is not as well known as it should be, possibly because it has not been handled by a publishing firm. New arrangements have now been made, and in future the tables will be sold by the Cambridge University Press.

Seismological Committee of the British Association

THE thirty-ninth report of this Committee is chiefly concerned with the maintenance of the International Seismological Summary. The University of Oxford has agreed to provide room and part of the working expenses until the time comes when these can be met entirely from sources outside the University, such as the International Union for Geodesy and Geophysics, the Crombie and Gray-Milne funds, and the British Association grants. The summary for the third quarter of 1930 is now in course of preparation, and in this the Committee is able to avail itself of the new Jeffreys-Bullen tables, the accuracy of which will greatly help in the determination of epicentres. The precision of the work now being carried on is evident from the suggestion that the time is approaching when the spheroidal form of the earth will have to be taken into account in the estimation of distances.

International Physiological Congress

THE Fifteenth International Physiological Congress will be held in Leningrad and Moscow on August 9–17, 1935, under the presidency of Prof. I. P. Pavlov. Arrangements will be made for visits, after the Congress, to various parts of Russia. The International Committee consists of Profs. Bottazzi, Frank, A. V. Hill, Howell, Johansson, Lapicque, Pavlov and the Congress Committee of Profs. Pavlov (president), Orbeli, Palladin, Beritoff (vice-presidents), Fedorov (general secretary), Volborth, Koshtojanz (secretaries). It will greatly assist the work of the Committee if physiologists intending to be present enrol as early as possible. Correspondence concerning the Congress should be addressed to Leningrad, Main P.O., Box 13.

Iron and Steel Institute

AT the general meeting of the Iron and Steel Institute in Brussels which opened on September 10, it was announced that H.M. the King of the Belgians, Leopold III, has honoured the Institute by accepting nomination as honorary member. This continues the tradition by which H.M. King Leopold II (1874–1909) and H.M. King Albert I (1913–1934) had been honorary members of the Institute. The Council is proposing Sir Harold Carpenter for election as president at the annual meeting of the Institute in May 1935, and Mr. James Henderson, deputy chairman and general manager of the Appleby Iron Company, Ltd., and of the Frodingham Iron and Steel Company, Ltd., and president of the British Iron and Steel Federation, has been elected honorary treasurer in succession to Sir Harold Carpenter, who is resigning at the end of September. The date of the annual meeting for 1935 will be May 1–3.

Announcements

THE following gold medals of the North East Coast Institution of Engineers and Shipbuilders have recently been awarded: Engineering Gold Medal to W. T. Bottomley, E. W. Corlett and Frank Piercy for their paper entitled "The Possibilities of Applying Improvements Effected in Modern Land Power Plant to Ship Propelling Machinery"; Shipbuilding Gold Medal to N. M. Hunter for his paper entitled "The Electric-Welded Ship *Peter G. Campbell*".

THE second meeting of the Microchemical Club will be held at Reading on September 29. At 11 p.m. the Club will meet at the University for the discussion of papers, and after luncheon a visit will be paid to the National Institute for Research in Dairying, Shinfield, where demonstrations will be given.

DURING the forthcoming winter it will be possible for Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, Harpenden, and other members of the staff, to give lectures to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted experiments. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

A CONFERENCE of malting barley growers and malting barley buyers and maltsters will be held at the Rothamsted Experimental Station on October 10, at 11.30 a.m., when the chair will be taken by Mr. Stanley O. Ratcliff, president of the National Farmers' Union. The purpose of the conference is to enable buyers and maltsters to meet growers and discuss with them the grading of samples. Further information can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A demonstrator in applied mechanics at the Royal Naval College, Greenwich—The Adviser on Education, Admiralty, Whitehall, S.W.1 (Sept. 17). Veterinary officers for the Administrative Counties of East and West Suffolk—The Clerk of the Local Authority, County Hall, Ipswich (Sept. 20). Civilian garrison engineers for the Establishment for Engineer Services at Army stations in Great Britain and Northern Ireland—The Under-Secretary of State (C. 5), The War Office, London, S.W.1 (Sept. 22). A lecturer in power plant at the Polytechnic, Regent Street, London, W.1—The Director of Education (Sept. 24). A botanical specialist and an animal breeding specialist in the Fouad I Agricultural Museum, Egypt—The Under Secretary of State, Ministry of Agriculture, Cairo (Sept. 30). A lecturer in physiology at the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London (Oct. 17).

Letters to the Editor

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Wasting Disease of *Zostera* in American Waters*

THE unprecedented widespread occurrence and devastating nature of the prevalent disease of the eel-grass, *Zostera marina*, have been viewed with considerable concern by those directly affected by its disappearance. To plant pathologists and marine biologists, the ecological changes following the total disappearance of the plant from our Atlantic coast[1] and from the western coast of Europe[2] have been a matter of special interest.

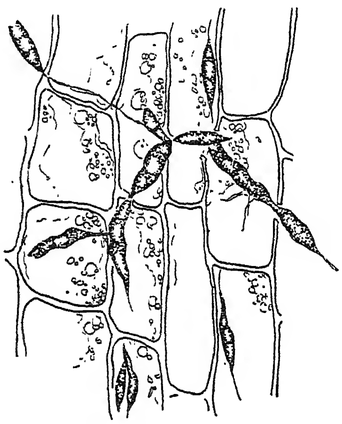

FIG 1. Diagram showing association of the *Labyrinthula*-like organism within leaf tissue of *Zostera marina*.

In the summer of 1933, with the return of sporadic growths near Woods Hole and at various points on the eastern coast[2,3], there was begun in these laboratories a search for an agent responsible for the spotting and darkening of the leaves that are symptomatic of the disease. A number of bacteria were isolated from diseased specimens but none of these demonstrated pathogenicity satisfactorily, although it has been claimed that bacteria are the causative agents[4,5,6]. Further, we have been unable to observe the *Ophiobolus*-like fungi reported by other investigators as commonly occurring on the rhizomes and leaves of diseased plants[7,8]. Rather, all of the specimens that we have examined, taken from various points along the coast and secured locally, show the presence, within the air spaces and in cells of the diseased leaves, of thin-walled, tenuous, spindle-shaped organisms. Their detection in preserved tissue depends upon careful fixation and staining as they are but slightly refractile. They are very difficult to observe in the living tissue, though, it might be mentioned, this has been done.

From our superficial examination the organism appears to be a mycetozoan very similar to the *Labyrinthula* described long ago by Cienkowski (1876), as parasitic upon filamentous marine algæ[9]. The individual organism is spindle-shaped with terminal, often branching, tenuous pseudopods. The air spaces of infected leaves are filled with net-like aggregates of these bodies, the members of which are attached to each other by their filamentous pseudopods.

In zones about the discoloured areas they may occur in more loosely organised chains. Within the cell they bring about disorganisation of the chloroplasts and disintegration of the nucleus—the cell wall is not attacked except at the point of entrance of the delicate pseudopod (see Fig. 1).

The life-history of the organism has not yet been studied in great detail. Further, although it is almost universally present in freshly collected diseased leaves observed by us, we are not satisfied that it is the causative agent of the disease, though it is placed under suspicion as a possible factor. The necessary isolation and inoculation experiments are under way in our laboratories. Despite the unfinished nature of our work, we believe the association of the organism with the diseased condition as found by us to be of sufficient importance to merit the earliest possible attention of those interested in the disease.

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and
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New Brunswick, New Jersey.
July 20.

[1] Cottam, C., *Plant Disease Reporter*, 17, (6), 46–53; 1933. (10), 1933.
[2] Cotton, A. D., NATURE, 132, 277, Aug. 19, 1933.
[3] Adams, J., NATURE, 132, 483, Sept. 23, 1933.
[4] Fischer-Piette, F., Heim, R., and Lami, R., *Bull. Labor. Marit. St.-Servan*, 10, 17; 1932.
[5] Fischer-Piette, F., Heim, R., and Lami, R., *C.R.*, 185, 1420; 1932.
[6] Heim, R., and Lami, R., *Ac. d'Agr. France*, Ext. Pr. verbal de la Seance, Juin 14, 1933.
[7] Mounce, I., Report of Biological Board of Canada, 1933, Ottawa, 1934.
[8] Petersen, H. E., NATURE, 132, 1004, Dec. 30, 1933.
[9] Cienkowski, L., *Arch. Microscop. Anat.*, 3, 274; 1867.

* Contribution No. 53, Woods Hole Oceanographic Institution and Journal Series Paper of the N.J. Agr. Exp. Station.

Vision in the Ultra-Violet

ALTHOUGH normal visible light is generally considered to extend from 7500 A. to 4000 A., most spectroscopists are familiar with the fact that the 3650 line of the mercury spectrum is quite visible. Saidman and Dufestel reported[1] that this latter line is visible after a period of accommodation, and that its colour sensation is identical with that of the 4047 A. line. They report that no lines farther in the ultra-violet are visible. I have recently found with the new Müller-Hilger universal double monochromator normal vision down to 3125 A. This instrument gives monochromatic light of a high intensity and of a very high degree of purity. The purity was confirmed by means of calibrated filters. The 'object' for these tests was the slit of the monochromator, across which were placed two wires $\frac{1}{8}$ in. apart. Most of the observations listed below have been confirmed by eight observers. There were no failures to confirm.

Light of 3125 A. also produced a violet colour sensation similar to that of 4047 A. Considerable difficulty was experienced in focusing the object, unless it was within 4 in. of the eye. When in focus, it appeared to be 9–12 in. away, and the wires appeared to be $\frac{1}{4}$–$\frac{3}{8}$ in. apart. This illusion was very definite and is to be expected, owing to the presumably higher refractive index of the proteins of the eye lens for this wave-length. On removing the eye to a

distance beyond 4 in., the object appeared to recede to a great distance and suddenly to become out of focus. At a distance of 6 ft., the object appeared only as a large ring of about 6 in. diameter. These tests were carried out with a light-adapted eye, and indeed the object could be seen in the normal lighting of the room.

The 3390 A., 3650 A., and 3906 A. mercury lines could also be seen, and gave similar colour sensations. The focusing problem was similar to that above, but to a progressively lesser degree.

With the 3023 A. line, no impression on the retina was observed, but only a pronounced fluorescence of the front part of the eye. This fluorescence was also obtained to a slight degree with the 3125 A. line, but the two effects were quite separable, the fluorescence being merely an illumination with no sense of direction, similar to that produced by a bright light with a closed eyelid. Even with the dark-adapted eye, it was impossible to be conscious of the position of the object when illuminated with light of 3023 A.

No vision nor fluorescence was obtained with either 2536 A. or 2625 A. mercury lines.

The sharp cut-off of vision between 3125 A. and 3023 A. is probably due to a threshold of absorption of light by the proteins of the eye lens, and such a threshold is indicated by the work of Tetsuo Abe[2]. The similarity in the colour sensation of the ultraviolet needs quantitative confirmation, and it may lead to an elucidation of the theories of colour vision.

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July 11.

[1] *C.R.*, **182**, 1173; 1926.
[2] *Arch. Phys.-Biologique*, **6**, 1; 1927.

Analysis of Profiles of Helium Lines in Spectra of *B* Stars

NEAR the normal positions of the diffuse series lines of both par- and ortho-helium, one finds very broad absorption lines in the spectrum of many

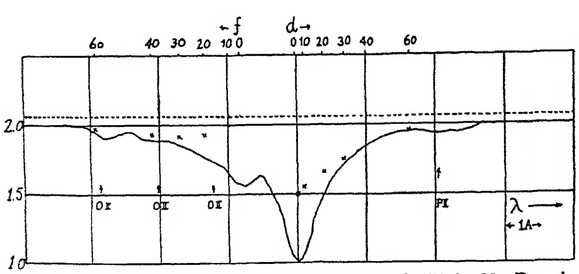

FIG. 1. Profile of the helium group including λ4471 in 88γ Pegasi.

B-type stars. The symmetry of each structure is imperfect in that the violet side represents the stronger absorption, and the profile indicates a complex nature. The purpose of this note is to point out in more detail the characteristics of the profiles, and to suggest possible origins of the main features.

So far as the Stark effect is concerned, we know that the diffuse lines are displaced towards the red only, so that the exceptionally strong violet absorption cannot be attributed to Stark effect on these

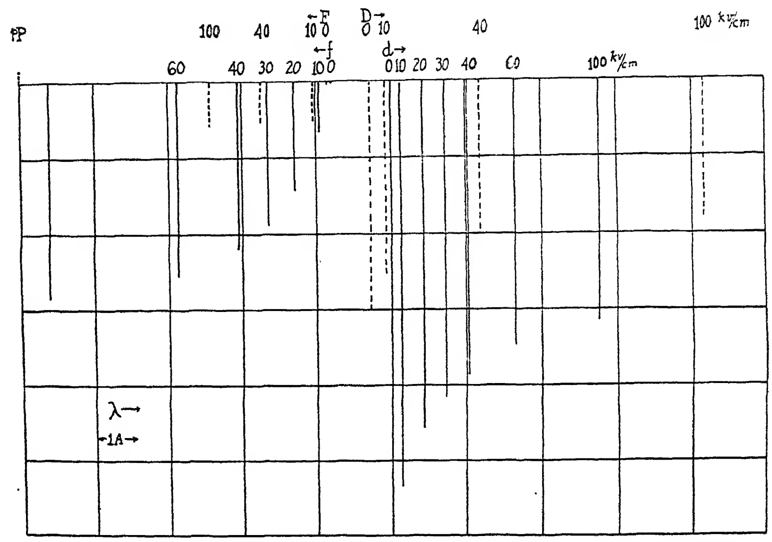

FIG. 2. Theoretical displacements and intensities of helium lines $2p$–$4d$ and $2p$–$4f$ in electric fields.

lines. Nevertheless, clear evidence for the presence of electric fields is found in certain combination lines ($2p$–$5f$, $2P$–$5F$) which remain in nearly the same position at all fields, and hence project sharply into the general profile. Assurance on this point forces us to attribute a generous portion of the red side of each diffuse line to Stark effect. Since electric fields produce no counterpart on the violet section of the *d* line itself, a very large portion of the violet profile remains to be explained upon some basis other than that of a broad diffuse line.

From our earliest plates of four class *B* stars, it seemed possible to find a qualitative explanation of the contours on the assumption of multiple electric fields in the stellar atmospheres, and, in fact, much remains to be said about the distribution of fields. From quantitative considerations, however, it immediately becomes clear, that it is quite impossible to account for all of the violet structure by Stark effect alone. The new lines have not the right wave-length to explain a large fraction of the stellar absorption; neither have they sufficient intensities. As a result, we find on the violet side of each diffuse line in the stellar spectra, a large section which, both as regards position and intensity, cannot possibly be explained on the basis of Stark effects. By subtracting the maximum possible Stark structure (as determined from the observed red *d* profile) a residual helium line or band is found near λλ4922, 4471, 4388, 4026. The position of the maximum in this band is 1·2 A.–1·7 A. from the diffuse line.

A good example is afforded by λ4471 ($2p$–$4d$) as it appears in 88γ Pegasi of spectral class *B*2. Fig. 1 is a profile averaged from nine three-prism spectrograms of this star taken at the Dominion Astrophysical Observatory. A wedge calibration served to reduce the microphotometer tracings to intensity profiles

for each plate. Fig. 2 illustrates the known displacements and intensities of $2p$–$4d$ and of $2p$–$4f$ in electric fields 0–100 kv./cm. Assuming (roughly) that the portion of the d line due to electric fields is as indicated by the crosses, the ratios in Fig. 2 make possible the calculation of the f line at corresponding fields as indicated. Even if one takes the entire d broadening as Stark effect, there is very little change in the calculated f line, owing to its very small relative intensity in low fields. If we consider, further, that we have here to deal with absorption wherein the maximum is about one half of the continuous background, a small increase of relative intensity is obtained for the f line, but this is of no vital importance to the present discussion. The 'residual' line at about λ4470·1 is seen to have considerable intensity.

In the above discussion, we have assumed that we have to deal with pure absorption. If appreciable emission is present to reduce the effective d absorption, it might be thought possible to retain the whole of λ4470 as a Stark line produced in absorption and not present in emission. When the whole of the recorded Stark effect is considered, however, such speculation leads to great difficulties. For example, the $p - p$ combinations and the lines $2p$–$5f$, $2P$–$5F$, should show a corresponding strength relative to the diffuse lines. Since these new lines actually show no intensity beyond our expectations based on pure absorption, it is certain that emission cannot be introduced to account for the whole of our 'residual' line as Stark effect.

We express our thanks to Dr. J. S. Plaskett for the opportunity to work at Victoria, and to Drs. Beals and Hogg for additional plates taken during the present year. The investigation has been aided by grants from the National Research Councils at Washington and Ottawa.

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A. Vibert Douglas.
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McGill University, Montreal.
June 5.

The Atmospheres of the Giant Planets

In their article on the atmospheres of the giant planets[1] Drs. A. Adel and V. M. Slipher suggest that a predominantly hydrocarbon structure might not be at all unlikely for these planets; this conclusion is also indicated, in their opinion, by the fact that the mean densities of these celestial bodies are in a class with densities of most organic liquids.

In a recent paper[2] I tried to explain the low densities of the four outer planets by a modification of certain conceptions of H. Jeffreys, which now may be considered as well established and in accord with the leading ideas of geochemistry. The giant planets are supposed to consist of a core (density 5·5, similar in structure to the earth), a thick layer of ice (density 1·0 under very high pressure) and uppermost, a layer of condensed gases (highly compressed, density 0·35), mainly hydrogen. The mass ratio of the different layers (each supposed as homogeneous) is then fixed by the observed values of mean density and moment of inertia. The numerical evaluation proves a mass ratio of hydrogen to heavy elements which is of the same order of magnitude as in the sun. This result is consistent therefore with the current conceptions about the origin and evolution of the giant planets (formation from ejected solar matter, with no considerable loss of volatile constituents).

This scheme of the internal constitution of these bodies seems to be preferable to the hydrocarbon hypothesis, because it avoids special assumptions. Nevertheless, the remarkable abundance of the saturated hydrogen compounds ammonia and methane requires explanation with respect to their origin and stability. A recent letter from Dr. H. Jeffreys to me stated that "some astronomers here are still disinclined to believe that they [that is, Jupiter and Saturn] are not red-hot". I therefore take this opportunity to point out that the existence of ammonia and methane is quite incompatible with an atmospheric temperature of about 1000° abs., because these compounds are strongly dissociated in this range of temperature. I had omitted to emphasise this fact when I made the first tentative identification of ammonia and methane in the planetary atmospheres, and I may now add that probably these gases are also fairly stable under the influence of the ultra-violet solar radiation. The above quoted model involves the assumption that the atmospheres should contain no oxygen and, therefore, be transparent to solar radiation down to 2200 or 1800 A., the upper boundaries of continuous absorption of ammonia and methane, respectively. From the results of laboratory experiments one would expect that in the absence of appropriate acceptors for free hydrogen atoms, the photochemical decomposition of ammonia and methane would be followed by a nearly complete recombination.

With further knowledge about the photochemical processes in the Schumann ultra-violet and their secondary reactions, it will perhaps be possible to obtain indirect evidence or to exclude the existence in the planetary atmospheres of such compounds as give no absorption bands in the accessible region of the spectrum, but which would play an important rôle as partners in secondary reactions.

R. Wildt.
Universitäts-Sternwarte,
Göttingen.
Aug. 5.

[1] Nature, 134, 148, July 28, 1934.
[2] *Göttinger Nachrichten*, 67, No. 5; 1934.

Origin of the Cosmic Corpuscles

The investigations of A. H. Compton and his associates on the dependence of the intensity of cosmic radiation on latitude support the theory of Lemaître, in which cosmic rays are treated as corpuscular, while the experiments of Kunze and others have established the existence in association with the radiation of charged particles with energies as great as ten thousand million volts. It has been customary to assign the origin of these corpuscles to some process of atomic construction or destruction in outer space, and to consider the earth as an uncharged isolated body upon which the corpuscles are showered from all directions.

I should like, however, to point out that the observed effects are well explained on the hypothesis that the earth is an electrified sphere at a potential of some millions of volts, to which the charged corpuscles, originally of small energies and of interplanetary location, are drawn by electrostatic attraction.

A conductor of the dimensions of the earth, although charged to a potential of many millions of

volts, would be surrounded by an electrostatic field of relatively feeble intensity. For example, the electric intensity at the surface of a charged conducting sphere of radius $6 \cdot 4 \times 10^8$ cm. (radius of earth) at a potential of 10^6 E.S.U. (300 million volts) is 1/640 E.S.U. per centimetre (0·47 volt per centimetre), and the surface density of charge $1 \cdot 24 \times 10^{-4}$ E.S.U. per square centimetre, so that a spherical shell of atmosphere only 1 kilometre in thickness charged with electrons at a concentration of 2·6 electrons per cubic centimetre would suffice to give the earth a negative potential of this value. It is, therefore, possible for the earth to possess a potential of this order, with no striking consequences at its surface.

In seeking a possible origin for such a charge, it is natural to examine Størmer's theory of the polar lights, according to which streams of charged corpuscles enter the atmosphere at comparatively small velocities. If these are assumed to be electrons of solar origin, it is evident that in such a stream the earth, simulating the grid of a triode, would assume a negative potential, the value of which depends on the numbers and energies of the solar electrons, and on the rate of loss of negative charge by it due to the capture of positive corpuscles and the escape of electrons from the atmosphere. In the condition of equilibrium, electrons expelled from the sun with energies of some millions of volts would approach the earth with greatly reduced velocities, and the electrostatic field due to the earth's charge, by spreading the incident beam, would probably assist the magnetic field in directing the electrons into the polar regions.

The large energies of cosmic corpuscles may accordingly be supposed to be derived indirectly from the sun acting in combination with the earth to form a cosmic electrostatic generator of the Van de Graaff type, which maintains the earth at a large, but not of necessity constant, negative potential.

Thus, the hypothesis, which I have suggested above, of a charged earth, affords a simple explanation of the two principal features of cosmic corpuscular radiation, namely, the enormous energies of the corpuscles and the absence of any favoured direction of approach. It suggests that the incident corpuscles are similarly charged and of comparatively local origin, and it is at the same time consistent with the observed fact of the small velocities of approach of the corpuscles responsible for the polar lights.

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Aug. 16.

The Museum of Practical Geology

IN the article on the Museum of Practical Geology in NATURE of July 28, p. 129, it is stated that the Treasury allotted £300 a year for the upkeep of the "Ordnance Geological Survey". While, however, this is the impression to be gained from published sources of information, the actual facts are, briefly, as follows :—

In 1832, De la Beche offered to colour geologically "eight sheets of the Ordnance Map of England, comprising Devon, with parts of Cornwall, Somerset, and Dorset" for the sum of £300. In 1835 he informed the Board of Ordnance that the maps had been completed, and suggested that the work should be extended to other areas. Following upon a favourable report by a small committee representing the Geological Society (comprising Lyell, Sedgwick and Buckland), the Government decided "to direct the continuance of a Geological Survey on the scale of the Ordnance Maps". Col. Colby reported that the probable cost would be £1,000 per annum, "independent of any salary which it might be deemed proper to give to Mr. De la Beche".

Behind these bare statements of fact there lies an extremely interesting story which throws much light upon the state of geological knowledge at the time, and upon the perseverance of De la Beche himself. A mistake in the identification of certain strata by De la Beche jeopardised the scheme almost before it was fairly launched, and but for the sympathetic interest displayed throughout by Col. Colby it might well have been completely wrecked.

For some years past I have been gathering material relating to this phase of geological history, and, through the kindness of Col. J. I. D. Nicholl and Mr. H. S. Gordon (the former a descendant of De la Beche, and the latter of Buckland), also Prof. Sollas and the Director of the Ordnance Survey, have been able to peruse much relevant correspondence. There are, however, still gaps in the story, and I shall be grateful to receive news of unpublished letters that passed between the pioneers (especially De la Beche, Buckland, Conybeare, Lyell, Sedgwick and Murchison), should any such letters be in the possession of readers of NATURE.

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Aug. 14.

Origin of the Wever and Bray Phenomenon

IT has been shown by Witmaack and more recently confirmed by Kaida[1], that following division of the VIII nerve in the cat central to the peripheral cochlear and vestibular ganglia, the ramus cochlearis fails to conform with the well-known Wallerian law in that the nerve elements including the spiral ganglion distal to the point of section undergo degeneration. In the following experiment, use has been made of this fact to adduce evidence bearing upon the problem of origin of the potential changes generated within the intact mammalian cochlea, in response and of a frequency corresponding to physiologically applied sound waves (Wever and Bray phenomenon).

Unilateral section of the VIII nerve was carried out in a full-grown cat. Six months later the electrical reactions of the two cochleæ were investigated. On the unaffected side, the Wever and Bray potentials, as also the potentials in the corresponding auditory tracts, were found to be of high amplitude and were recorded after suitable amplification upon moving ciné-bromide employing a cathode ray oscillograph. Upon switching over to electrodes already placed in position upon the affected cochlea and corresponding auditory tracts, no response could be elicited to any frequency (100∼ – 6000∼) using higher intensities of sound (some 40 decibels) with maximum amplification.

Intra-vital fixation of the two ears was at once carried out. This procedure followed by celloidin embedding made possible a highly critical examina-

tion of the histological features of the two ears concerned. On the affected side, all neural elements in the cochlea had disappeared apart from a few scattered and atrophic members of the spiral ganglion and some neurilemmal remnants. All other features of the affected cochlea, the rods, and hair cells of Corti's organ, Reissner's and the tectorial membrane, the stria vascularis, and the capillaries with contained fresh blood cells, were perfectly preserved and indistinguishable morphologically from these structures as found in the opposite unaffected ear, in which, however, the ganglion cells and other neural elements were present in normal numbers and preservation. No abnormalities were present in the middle or external ear on either side.

Since thus the only demonstrable histological difference between the two ears was the absence of neural elements upon the side exhibiting a conspicuous and carefully attested absence of electrical response, it is considered that the experiment described furnishes striking evidence, though of a purely morphological character, in support of the view that the cochlear potential changes constituting the Wever and Bray phenomenon are of neural origin.

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London, W.1.

[1] Kaida, Y., *Jap. J. Med. Sci.*, 12, 1, No. 2, 237; 1931.

Wing Pattern in Butterflies

THE genus *Lethe* (Lepidoptera, Satyridæ) belongs to the largest in its family and is therefore of considerable interest as to the dependence of its wing-pattern upon the general Nymphaloid prototype established by one of us[1]. In spite of the fragmentary character of materials at our disposal, we have been able to ascertain that the above prototype represents a basis of the wing-pattern of *Lethe*, just as is the case in a number of other genera of Nymphaloid families[2].

Besides this main fact, several directions of wing pattern evolution have been studied in *Lethe* by the method of comparative morphological series, and some remarkable processes discovered. Perhaps the most striking of them is the group of processes culminating in the wing pattern of *Lethe argentata*. A number of dislocations, ruptures, coalescences and other modifications affecting the prototype components result in the fact that the general appearance of *argentata* pattern reminds one in a way of that of the swallow-tail *Papilio podalirius*, though the homologies of the two are, of course, very different. A very demonstrative example of the 'destruction' of prototype stripes and spots by the light interspaces lying between them has been discovered, and some other interesting phenomena recorded.

A paper dealing with the above data is now in press in the *Acta Zoologica*.

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July 5.

[1] B. N. Schwanwitsch, *Proc. Zool. Soc. London*; 1924.
[2] B. N. Schwanwitsch, *Zeit. Morph. Oekol. Tiere*, 13; 1929. 21; 1931. B. N. Schwanwitsch, *Trans. Zool. Soc., London*, 21; 1930.

Sparrows and Bees

THE weather of the first fortnight of July 1934 was abnormally hot and dry, which condition may account for the following interesting observations made on two hives of bees, in the garden of the Convent of Notre Dame, Ladywood, Milngavie, near Glasgow.

One hive had not swarmed, and was very strong. Drones were leaving it during the middle of the day in fairly good numbers. They did not seem to have power of flight, due perhaps to the fact that worker bees had given them an injection or starved them. (This onset of what looked like preparation for winter conditions may have been induced by lack of moisture to form a sufficient quantity of nectar. The hive became normal when damper weather returned.)

Sparrows were evidently suffering from the drought, and consequently took advantage of the helpless condition of the drones to pounce upon them, kill them, much as a bird does a large worm, eat them, and especially one pair of birds, feed their young, still in the nest, under the roof of the house. They then began to attack and carry off the worker bees, catching them on the wing, or as they fell heavily laden to the ground, before they had time to rise. Both cock and hen did this, but the hen was especially daring. She perched on a vertical rod in front of the hive, and dived on to the alighting board time after time and never failed to carry off a bee. The hive was a very busy one, so it was fairly easy to secure a victim, on account of the crowded condition of the alighting board.

An improvised netting protection failed to deter the depredations of the sparrows, who crept under and went on. Some bread and milk and other dainties placed nearby at last tempted them away, and with the onset of moist weather they eventually abandoned the attack.

The sparrows made no attempt to go to the second hive, which was weaker, having thrown off two big swarms. Since there were fewer bees going in and out, they were less easy to secure, and a miss might have aroused the ire of the rest and brought out an angry attacking force.

The bees are French black or grey like the British. Though the stocks originally consisted of one Dutch, and the other French, the Dutch seem to have disappeared and only French remain.

SISTER VERONICA.

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July 30.

Design of Theodolite Axes

THE 'Wild precision theodolite'—a light-weight type of primary triangulation instrument—is well known for the ingenuity and compactness of its design as well as for the superb workmanship exhibited in its construction. The couplings of the instrument mechanism, however, are designed on machine tool principles, and although the tolerances on the cylindrical fits of the axes are very small, a recent investigation by J. L. Rannie and W. H. Dennis[1] of the Geodetic Survey of Canada, Department of the Interior, Ottawa, has shown that the performance of a number of these instruments was not satisfactory.

Many consider that the highly accurate perform-

ance of such an instrument as the theodolite when carefully made is sufficient proof that axes designed as straight or slightly tapering cylindrical members fitting their mating elements with extensive surface contact are good enough for any instrument and nothing further need be said. But it is not possible without extraordinary precautions to make geometrically perfect cylindrical elements, and though the deviation from geometrically circular form in manufactured elements may not be sufficiently great to affect the readings of a theodolite by axis shift during rotation of telescope or circles, it may easily give rise to a serious source of error by slight but variable resistance to motion which is communicated to the instrument indications as a strain shift in an irregular manner. With decrease of the tolerances a more pronounced effect of this kind during relative motion of the two elements would be expected, and when the clearance between the functional surfaces reaches very small dimensions, the shearing of the lubricant may also cause the pointings and circle readings to change with time.

These defects will appear in the indications as systematic errors confused with the accidental errors, since the probable error is merely a measure of the agreement of average repeated readings and is not a measure of the accuracy of a reading. The two kinds of error can be separated, however, by devising special tests to establish a standard probable error of the accidental errors peculiar to the instruments and methods used. The systematic errors will then be revealed as an increment of the standard probable error.

It is by such specially arranged tests on the Wild instruments that Rannie and Dennis have been able to separate the systematic errors known to exist. "All of the evidence, . . . , indicated that angular errors of appreciable magnitude—of the order of 2″ to 4″—may have resulted from strain or other axis trouble in at least nine of the 10 Wild theodolites examined."

The authors then proceeded to modify the alidade and telescope axes so that the unavoidable imperfections of geometric form would have no effect upon the instrument indications. That is to say, when the telescope was rotated in azimuth or transited, no irregular resistance to the movement would take place and consequently no elastic deformations would upset the circle readings.

The original paper should be consulted for the details of the modifications the authors were able to make, but it is sufficient to state here that the alterations to the axes conformed to kinematical principles as closely as the existing design would permit. After each instrument had been remodelled in this way, it was again taken through the previous tests, which showed that not only had the systematic errors been eliminated but also that in addition the accidental errors had been slightly reduced.

This paper, embodying the results of exhaustive tests upon the performance of certain theodolites by the Chief of the Triangulation Division and the District Engineer of the Geodetic Survey of Canada, surely must be regarded as one of the most important, if not the most important, contribution to the design of theodolites in particular and of measuring instruments in general which has hitherto been published.

It has conclusively shown that the usual machine-tool design applied to an instrument of high precision, no matter how perfect the workmanship may be, is fundamentally wrong. It has shown that even an approach to correct or kinematic design of the couplings at once improves the reliability of the instrument indications, and incidentally it has shown that equally strict attention must be given to the design of subsidiary parts, such as levelling screws, if the best results are to be obtained.

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Aug. 3.

[1] "Improving the Performance of Primary Triangulation Theodolites as a result of Laboratory Tests", *Canadian J. Research*, **10**, 347; 1934.

Accuracy of Least Squares Solutions

I HAVE recently obtained the solution of this problem: Given n linear equations of condition in m unknowns, and that (1) the set of errors of the equations of condition are a sample drawn at random from a normal population of unknown standard deviation σ, and that (2) nothing more is known about the values of the unknowns or of σ than that which can be inferred from the equations of condition, then (A) what are the values of the unknowns? By rigorous, direct methods, and with no further assumptions, I have obtained the distribution functions in answer to question (A). They are the same as those which Jeffreys[1] obtained in semi-intuitive fashion, by making the somewhat arbitrary assumption that the "prior probability" that σ lies in a certain range $d\sigma$ is proportional simply to $d\sigma/\sigma$.

I have also obtained by direct arguments, with no assumptions other than (1) and (2), the answer to question (B): What is the value of σ? This distribution function is considerably more complicated, involving m and $\Sigma\delta^2$ as it should, than $d\sigma/\sigma$; and if one uses the function as a "prior probability", one can obtain in this second, indirect fashion the same answer as before to question (A). I think that Jeffreys's conclusions were highly creditable to his insight, although I am compelled to agree with Fisher[2] and Bartlett[3] that his arguments were fallacious. I shall publish the new treatments in due course.

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June 25.

[1] Jeffreys, *Proc. Roy. Soc.*, A, **138**, 48; 1932.
[2] Fisher, *Proc. Roy. Soc.*, A, **139**, 343; 1933.
[3] Bartlett, *Proc. Roy. Soc.*, A, **141**, 518; 1933.

Velocity of Reactions in Solution

IN a recent publication, Williams and Hinshelwood[1] reach the important conclusion that the influence of substituents on the velocity of benzoylation of aromatic amines in benzene solution depends principally on changes in the activation energy, that is, E in the expression $k = PZe^{-E/RT}$. Changes in P, a factor independent of the activation rate, are of much smaller importance as long as the medium is unchanged.

This publication is welcomed as affording lateral support to the conclusion already reached by my collaborators and myself on the basis of (1) the temperature effects, and (2) the additive effects observed, that the relative rates of chlorination of substituted phenyl and tolyl ethers in 99 per cent acetic acid are dependent solely on the activation energies. A summary and discussion of these results, which appear to have been overlooked by Williams

and Hinshelwood, are given in *Chemistry and Industry*[2], where full references are to be found. An extension of the measurements to the bromination of ethers in 50 and 75 per cent acetic acid indicates that, within the range so far examined, change in medium and/or reagent is accompanied by a change in the activation energy such that $E_1 = mE_2$, where m is a constant independent of the constitution of the ether. Details of these measurements will be published later.

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[1] *J. Chem. Soc.*, 1079; 1934.
[2] *Chem. and Ind.*, 254; 1932.

Urobilinogen

SINCE Fischer and Meyer-Betz isolated crystals of mesobilirubinogen from a pathological urine[1], it has been generally assumed that urobilinogen and mesobilirubinogen are identical. However, Watson[2] was unable to reduce crystalline urobilin from fæces or urine to crystals of mesobilirubinogen.

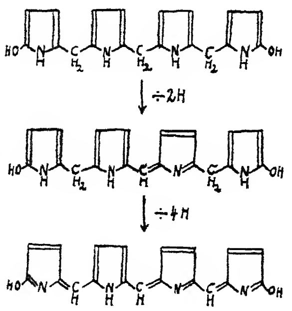
My experiments give further evidence of the non-identity of the two chromogens. Natural urobilin and 'urobilin' from mesobilirubinogen show a very slight, but definite, difference in the position of their absorption maxima in acid alcohol (490·9 and 493·2 mμ respectively in the Hartridge reversion spectroscope). With ferric chloride, mesobilirubinogen and also its 'urobilin' are dehydrogenated to mesobiliverdin and mesobiliviolin, whereas urobilinogen from normal urine and fæces and from pathological urine (splenic anæmia) is only changed into urobilin[3]; the latter is completely stable against ferric chloride. It makes no difference whether urobilinogen is obtained directly from urine or fæces or by reduction of urobilin with sodium amalgam; nor is mesobilirubinogen changed into urobilin, if subjected to the procedures involved in the preparation of the latter from fæces or urine.

These observations prove that the two chromogens differ in their skeletal system, not (or besides) in the side chains. For the deep colour of the green and violet pigments is caused by a chain of conjugated

MESOBILIRUBINOGEN

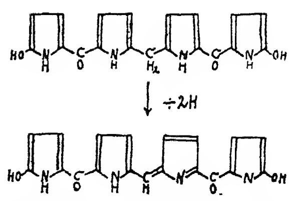
MESO"UROBILIN" (YELLOW)

MESOBILIVERDIN (GREEN)



UROBILINOGEN

UROBILIN (YELLOW)



double bonds going through the system of the four pyrrole rings. The assumption of two carbonyl groups standing between the pyrrole rings I and II and between III and IV in urobilinogen instead of two CH_2-groups in mesobilirubinogen would appear to be in agreement with the analytical findings of Watson for urobilin and would explain the impossibility of further dehydrogenation beyond the urobilin state. In the above formulæ the side chains have been left out. Experiments to prove the carbonyl groups and to reduce them to CH_2-groups are being made.

Thus urobilinogen is not a simple product of reduction of bilirubin by the intestinal bacteria, but a product of dismutation or oxidation of bilirubin. That the bile pigment is subjected to such processes in the intestine is shown by the presence of mesobiliviolin in the fæces (Watson). This contains four hydrogen atoms more than bilirubin in the side chains (two ethyl groups instead of two vinyls), but as I found recently, four atoms of hydrogen less than bilirubin in the skeletal system.

It seems extremely improbable, however, that Fischer was mistaken in the isolation and identification of his mesobilirubinogen. The only remaining explanation is that in some pathological cases (that of Fischer was one of liver cirrhosis[4]) mesobilirubinogen may occur instead of urobilinogen[5]. It seems not impossible that in cases of extensive liver damage, bilirubin is reduced by the liver, perhaps an infected liver, to mesobilirubinogen and that this reaches the kidney without passing the intestine[6]. The differentiation of the two urobilinogens is therefore of importance in clinical diagnosis. It should be mentioned that there is no reason for the clinician, who bases his determinations of urobilin directly or indirectly on the mesobilirubinogen standard, to get alarmed. There is apparently no difference between the two chromogens as regards their standard value for the Terwen—Ehrlich estimation.

RUDOLF LEMBERG.

Sir William Dunn Institute
of Biochemistry,
Cambridge. July 24.

[1] Fischer and Meyer-Betz, *Z. physiol. Chem.*, **75**, 232; 1911.
[2] Watson, *Z. physiol. Chem.*, **204**, 57; 1932. **208**, 101; 1932. **221**, 145; 1933. *Proc. Exp. Biol. and Med.*, **30**, 1207, 1210; 1933.
[3] Lemberg, *Chem. and Ind.*, **53**, 179; 1934.
[4] Fischer, *Z. f. Biol.*, **65**, 163; 1915.
[5] Hoesch (*Biochem. Z.*, **167**, 107; 1926) observed that some urines gave violin bands with ferric chloride, whereas others did not.
[6] Lichtenstein, *Münchener mediz. Wochenschr.*, **72**, 1962; 1925. Weiss, *Biochem. Z.*, **207**, 151; 1929.

Fish Liver Oils Rich in Vitamin A

THE outstandingly high vitamin A content of the liver of the halibut (*Hippoglossus hippoglossus*) has led to considerable commercial interest in any species giving a liver oil of a potency comparable with halibut liver oil. In the same family as the halibut, several of the larger species give rich oils, but they are not of the same order of potency as good halibut oils. Samples of sturgeon (*Acipenser* species) liver oils examined varied widely in potency, as with halibut liver oil, and seemed quite comparable, the best sample showing 4,000 blue units in the antimony trichloride test for 0·2 c.c. of a 20 per cent solution. Recently, the liver oil of the tunny fish (*Thunnus thynnus*) has been examined. The oil was rich in vitamin A, the blue values for three samples being 1,927, 1,993 and 2,724. The livers contained about 20–25 per cent of oil. The particular fish used were caught off Scarborough.

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Research Items

Lea Valley Mesoliths. A mesolithic site at Broxbourne has been described by Messrs. Hazzledine Warren, J. G. D. Clarke, W. A. MacFadyen and H. and M. E. Godwin (*J. Roy. Anthrop. Inst.*, 64, pt. 1). The industry lies above the deposits of the Tundra stage, which is to be correlated with the Magdalenian, and below the peat of the Boreal Forest epoch. The site is situated in Rikof's Pit in the Lea marches, east of Broxbourne railway station. The flints described come from one only of a number of sites identified. This site was small, not exceeding 15 ft. in diameter, and could have been occupied by few people only. The surface below the peat was sand. Owing to the conditions of examination, the flints may be regarded as a completely representative series, with the debris of manufacture, sealed by a peat deposit soon after manufacture. A number are calcined by fire. Five types of point, including micro-burins, are identified. There are also cores, burins, scrapers, axes and hammerstones. As regard its cultural affinities, Broxbourne belongs to the Forest Culture A, which correlates with the Boreal climatic period. Typologically, Broxbourne falls into the group of axe, burin and non-geometric microlith industries of south-east England, which represents an extension of the mesolithic forest cultures of Baltic lands; while by the pollen analysis, here described, it can be dated independently of typological considerations as belonging to Boreal times. Owing to the fortunate circumstances of its discovery and examination, and the incomplete character of the evidence from other similar sites in Britain, Broxbourne must be considered the type site of Forest Culture A in Britain. The Continental sites with which it may be compared are Svaerdborg, Mullerup, and Holmgaard in Sjaelland and Duvensee near Lubeck, all dated on botanical evidence to the Boreal period.

The Ovimbundu of Angola. Mr. Wilfrid D. Hambly, as leader of the Frederick H. Rawson-Field Museum Ethnological Expedition to West Africa, undertook research in Nigeria and Angola from February 1929 until February 1930, and made a study of the Ovimbundu of Portuguese West Africa and their culture contacts (Field Museum of Natural History, Chicago, *Anthrop. Ser.*, 21, No. 2). The Ovimbundu live on the central plateau of Angola, the Benguela Highlands, which rise in places to an altitude of 6,000 ft. Their villages are built on the hillside, and the nature of the ground affords them a natural protection from their enemies. There are two main physical types, one having a brown skin colour and slender build, while the other is a shorter, darker and more sturdy type. The Ovimbundu are Bantu negroes, who possibly result from a crossing of Hamites and true Negroes. This would account for both types. Topography and climate fix certain conditions, which favour agriculture and cattle-keeping on an extensive scale; while a sufficient rainfall favours the growth of timber serviceable for the craftsman. One of the fundamental factors in their economic life is the division of labour on a sex basis. In recent times, the loom and the conical furnace for smelting iron have disappeared, owing to the increasing importation of foreign cloth and the facilities for obtaining scrap iron. Bark cloth is no longer made. Drum signalling has declined with the decrease of warfare, and for the same reason the double gong is now rare. Originally the Ovimbundu were cannibals. This practice was intimately associated with slavery, as only slaves were eaten in the ceremonial feasts; but with the discouragement of inter-tribal warfare under the Portuguese, the capture of slaves became obsolete. There are numerous resemblances between the cultural pattern of the Congo region and that of the Ovimbundu of the present day. A number of cultural identities support the thesis that the Ovimbundu are of the central African matrix of culture.

American Opossums. A thorough revision of the genus *Marmosa* has been made by G. H. H. Tate (*Bull. Amer. Mus. Nat. Hist.*, 66, 1933), so that, with the new forms described, the genus now includes 49 species and 100 recognisable sub-species, all belonging to five well-marked groups. The bulk of the work, of 250 pages, is taxonomic, but the introduction contains much of general interest. Colour bears a relationship to environment parallel to that shown by some other groups of mammals and birds: the species of the humid Andean region are nearly all dark brown, the forest forms grey tinged with brown, the natives of the dry areas of Ecuador and Peru are grey. Certain definite trends suggest to the author that orthogenesis has been at work: there is a tendency for the pouch to disappear and the mammæ to spread to the pectoral region, for the primitive arboreal habit to be replaced by terrestrial or aquatic habits and for the development of a food-storage mechanism, as in the thickened tails of some southern genera.

Reduction of Carapace in Chelonians. It is a remarkable fact that although reptiles usually possess more ribs than other vertebrates, those reptiles—the Testudinates—in which the bony skeleton is most exaggerated have fewer ribs than the majority of mammals. Reduction of the carapace may be due to atrophy of some parts owing to hypertrophy of others, or it may be due to an inhibition of growth (P. E. P. Deraniyagala, *Spolia Zeylanica*, 18, May 1934, p. 211). Where the species is a land-living form, the inhibition affects only the bony corselet of the carapace but not the scales or scutes, but in aquatic forms both components of the carapace are reduced. Indeed, in pleurodirous forms, loss of scales and scutes precedes osseous inhibition. The loss, necessarily associated with aquatic habit, seems to proceed as follows. The marginals act as guards to the free ends of the ribs, and form a rim to support the dermal carapace which they raise off the plastron. These requirements are essentially terrestrial. In aquatic forms, inhibition of the costal plates isolated the costal marginals and, no longer necessary as a rim support in the new medium, they were the first to disappear. In water, the carapace no longer presses down upon the plastron, and since also the ribs, shortening in proportion to the length of the inhibited costal plates, could no longer be protected at their tips by marginals, all the remaining marginals became functionless and disappeared.

Cytogenetics of *Digitalis*. The genus *Digitalis* shows several interesting genetic and cytological features. Six European species, including *D. ambigua*,

D. purpurea and *D. dubia*, have $2n = 56$ chromosomes, while three species, *D. eriostachya*, *D. lutea* and *D. obscura*, belonging to southern Europe, are tetraploid, having $2n = 112$. A new constant tetraploid species, *D. mertonensis*, was produced a few years ago from a fertile F_2 plant derived from a cross between *D. purpurea* and *D. ambigua*. Messrs. B. H. Buxton and S. O. S. Dark (*J. Genetics*, 29, No. 1) record the results of various crosses between these species. The hybrids are generally matroclinous, and differences occur in the reciprocal crosses. In crosses between the diploid species the F_1 is completely sterile, as are also the hybrids between *D. mertonensis* and *D. lutea* or *D. eriostachya*. Although the last two tetraploid species are indistinguishable in their flowers, which are very small, yet their hybrids with *D. mertonensis* are markedly different. This appears to be due to genes expressing themselves in the hybrid but not in the parent species. In these hybrids there is much more pairing of the chromosomes than in crosses between *purpurea* and *ambigua*, from which it is concluded that the wild tetraploid species have originated in the same way as *D. mertonensis*. By crossing the latter with diploid species, various triploid tri-hybrids were produced, all of them sterile. It is concluded that in the evolution of the genus there was differentiation into at least two groups of diploid species with quite unlike chromosomes.

Researches on *Euchæto norvegica*. This is one of the largest known copepods, and has a wide range of distribution in northern waters. It is a very important fish food in America, but in Loch Fyne in the Clyde sea-area where it occurs in abundance it is never found in the stomach of the herring, which is surprising, for it is rich in oily matter. It probably, however, serves indirectly as herring food as *Meganyctiphanes* eats *Euchæta* and is eaten by the herring. Mr. A. P. Orr, in his paper "The Weight and Chemical Composition of *Euchæta norvegica*, Boeck" (*Proc. Roy. Soc. Edin.*, 54, Part 1, No. 5), describes the analyses of material taken from catches made in Loch Fyne in October and November 1931. The values of fat and protein differ considerably from those hitherto recorded for marine plankton which last were, however, based on mixed plankton catches and with smaller organisms. The present results show *Euchæta* to be a very rich food for fish, the fat content of adult males being about 23 per cent of the dry weight and that of non-ovigerous adult females 21 per cent, and the ovigerous females much fatter (36 per cent). The average value of the protein was 36 per cent. Dr. A. G. Nicholls in No. 4. of the same part of the *Proceedings* describes the developmental stages of *Euchæta norvegica*, reared by him in the Millport Laboratory. This is a very beautiful piece of work and those who understand the difficulties involved in rearing the young stages of any copepod will appreciate the care that must have been taken to attain the desired results. The six nauplii and first copepodite stages were successfully reared; good descriptions and figures are given and the growth and development compared with that of *Calanus*. It appears that *Euchæta* passes through its nauplius stages without feeding, being dependent on its large supply of yolk.

Insects and Spike-Disease of Sandal. Part 1 of vol. 20 (May 1934) of the *Indian Forest Records* consists of a paper by Messrs. Cedric Dover and M. Appanna on insect transmission of the above disease. These authors state that field investigations and biological analyses strongly support the conclusion that spike-disease is transmitted by insects. Experiments with 31 species of Hemiptera appear to confirm the theory previously advanced that *Moonia albimaculata* is a very possible vector. Suggestive symptoms have occurred in five well-defined cases, as the result of infection with viruliferous individuals of this species. Cytological study of the plants involved have, furthermore, revealed the presence of characteristic intracellular inclusions. In a single case an apparent infection by an aphid (*Macrosiphum*) is recorded as the result of transmission experiments. Their observations lead to the conclusion that mandibulate insects are not vectors of the disease. In a postscript to the above paper, Dr. C. F. C. Beeson, forest entomologist at Dehra Dun, mentions that the special grant subsidising spike-disease expired in 1933, and the investigation has had to be closed down. Further experiments dealing with the transmission of the disease by *M. albimaculata*, which were then in progress, had to be abandoned. While the various papers on the subject, so far published, will form a useful basis for any future research, the Board concerned with the investigation is not wholly agreed that the available evidence, so far obtained, affords conclusive demonstration that spike-disease has been experimentally transmitted by any species of insect.

Root Systems of Apple Trees. Messrs. W. S. Rogers and M. C. Vyvyan have recently reported the results of their continued studies on the extent and character of root systems of apple trees (*J. Pomol. and Hortic. Sci.*, 12, No. 2, 110–150, July 1934). The present investigation relates to twenty-six trees on various clonal root-stocks growing on three types of soil—loam, sand and clay. In all cases, the roots spread further than the branches, and fine roots grew in all directions. The ratio of the weight of stem to weight of root was 2–2·5 in loam soil, about 2·1 on clay, and 0·7–1 in sand. The ratio was comparatively constant for a given soil, and did not vary appreciably for trees of markedly different vigour. The deepest roots (9 ft. 6 in. below the surface) were found on Stock No. IX (very dwarfing), and generally speaking, the more vigorous stocks had shallower root systems. Earlier statements about the extent of root systems of apple trees are substantiated with further data, but the possible modifying influence of a water table is discussed. A useful appendix, describing the methods of excavation and grading, is added.

Plant Disease in Great Britain. The Ministry of Agriculture and Fisheries has recently issued Bulletin No. 79, "Fungus and other Diseases of Crops, 1928–1932" (London: H.M. Stationery Office, 2*s*. June 1934). The publication is a useful survey of fungus and virus diseases which have occurred in England and Wales during the last five years. Thirty-three plant pathogenic bacteria and fungi which are either new to science or have not been previously recorded for Britain, and twenty-eight uncommon species, are enumerated. Brief introductory chapters on weather conditions, progress in control measures, and scheduled plant parasites form a useful prelude to the descriptions of diseases. Host plants are subdivided under the following headings: cereals, potatoes, roots and fodder plants, pulse, pasture and forage crops, vegetables, fruit, hops, mushrooms and flax, ornamental plants, and bulbs, corms, etc. Extensive

indexes of parasites and of non-pathogenic and virus diseases enable the reader to review the latest findings on any particular problem in plant pathology. As knowledge expands, it becomes increasingly difficult for one worker to review the whole field even of his particular study, and the volume under notice is an excellent collection of up-to-date knowledge. Dr. G. H. Pethybridge, Mr. W. C. Moore and Dr. A. Smith are the joint authors, though much of the subject matter has been contributed by collaborators in all parts of the country.

Correlation by Radioactive Minerals. The age of the metamorphic rocks of eastern Connecticut has long been an unsolved problem. An important contribution towards its solution has been made by W. G. Foye and A. C. Lane (*Amer. J. Sci.*, August). Three analyses of uraninite by F. Hecht show that the Strickland pegmatites date back some 280–290 million years, indicating that they were injected during the Acadian orogenesis of late Devonian time. The Bolton schist, which is intruded by the Strickland dykes, can be correlated with the Brimfield schist of Massachusetts, and since both must be older than the Carboniferous, they cannot be correlated with the Worcester phyllite, which is known already to be of Upper Carboniferous age. The pegmatites are associated with the Monson granodiorite, and the Dedham granodiorite of Massachusetts is of the same age. Both igneous masses may therefore be reasonably referred to the Devonian. An important by-product of the investigation shows that the factor k in the lead-ratio $Pb/(U+k.Th)$ is about 0·36, as adopted in "The Age of the Earth" (Bull. 80, National Research Council, 1931), and not 0·25 as advocated by Kirsch. Fenner's analysis of a monazite (free from uranium) from the same Strickland quarry gives an age of 278 million years when the factor 0·36 is used. This result corresponds very closely with those for the uraninites, which are poor in thorium. Had the smaller estimate for k been used in calculating the age of the monazite, the latter would have been only 221 million years.

Specification of Optical Glass. It has been customary in the past to specify the properties of an optical glass by its refractive index n_D for the middle of the D lines of sodium and by its reciprocal dispersion, $v=(n_D-1)/(n_F-n_C)$ now called its constringence, where n_F is for the blue and n_C for the red line of hydrogen. This specification entailed three determinations of refractive indices. In a review of an extensive series of glasses available in Great Britain by Mr. T. Smith of the National Physical Laboratory (see NATURE, April 16, 1932, p. 584), it was pointed out that if the constringence were defined as $(n_F-1)/(n_F-n_C)$, only two determinations would be necessary. Mr. Smith also urged glass makers to publish charts in which each glass was represented by a point on n, log v scales. He showed also that for many glasses the change of n was proportional to the change of a power, not differing much from unity of the wave number of the transmitted light. In a new list of nearly 80 optical glasses, Messrs. Chance Brothers adopt the n, log v chart, but the logs are from 0·40 to 0·88 instead of from 1·40 to 1·88. They adopt n_D-1 where n_D is the refractive index for the yellow line of helium, for the numerator of the constringence and give the values of the partial dispersions throughout the spectrum in preference to using the suggested wave number power relation. An improvement which will be much appreciated by designers is the substitution of the specification of each type of glass by a number, the first three digits of which are the excess of the refractive index of the glass over unity and the remaining three the constringence, for the former method of using random letters or numbers.

Electric Waves in Insulators. The variations of the dielectric constants of insulating media with the wave-length of the oscillations they are propagating, and in particular the great decrease in value which takes place as the wave-length decreases from 1000 to about 1 metre, have been explained as due to conduction, which gives a 'normal' dispersion, to free periods of the molecules giving resonance, and to the existence of dipolar molecules the orientation of which is influenced by the electric field. Dr. Werner Ziegler has examined the experimental results available to determine to what extent the last two theories will explain 'anomalous' dispersion (*Phys. Z.*, June 15). For pure liquids—water, alcohols and ethers—the dipolar theory affords an adequate explanation, but for glycerine and insulating oils it is not satisfactory, nor is the resonance theory any better. For the oils, conductivity appears to play the most important part. For solid insulators, both conductivity and polar theories must be appealed to, while for gases the data available are not yet sufficient to show whether the resonance theory is adequate. References to more than a hundred recent papers are given.

Flow of Water under Structures on Sand Foundation. There has been issued from the Punjab Irrigation Research Institute in two parts (*Research Pub.*, 2, Nos. 3 and 4. Government Printing Office, Lahore. 5*d.* each) a dissertation by Dr. E. McKenzie Taylor, the director of the Institute, and Mr. Harbans Lal Uppal, assistant research officer, on the nature and lines of flow of water through sand under models which have been designed to give the effect of standard methods of construction. A full description of the apparatus is given in Part 1; it consisted of an experimental tank, 3 ft. 10 in. long, 2 ft. 6 in. deep and 2 ft. wide, with pipe connexions for draining away the water and providing an outlet for the sand. The model, made in teak, having been inserted in the tank, with watertight jointing at the sides, the stream flow was studied by means of the reaction between solutions of potassium chromate and silver nitrate, each of 1 per cent strength. The sand was first saturated with the potassium chromate. Silver nitrate was then introduced at intervals into the sand on the upstream side by means of a series of tap funnels the points of which were drawn out so as to give a fine stream. The silver nitrate reacted with the potassium chromate and gave a red precipitate along the line of flow, which was then photographed through the glass plate with the aid of suitable illumination. A number of photographs are reproduced in the pamphlets showing the stream lines under an impervious floor and under various types of foundations of sheet piling and impervious aprons. It is stated that probably the most important result obtained from the experiments is the observation that 'creep' (that is, a major line of flow in contact with the work) is non-existent. This may have an important bearing on future design. It is added that a floor protected by upstream and downstream sheet piles and aprons appears to be the most stable form of work possible.

International Federation of Eugenic Organisations

THE eleventh Assembly of the International Federation of Eugenic Organisations was held in Zurich with various conferences on July 18–21 under the presidency of Prof. E. Rudin. Eighteen members of the Federation attended the Assembly, and visitors to the conferences brought the total number to more than fifty. As in previous years, the conferences were limited to a few topics, namely, feeblemindedness; the analysis and genetics of mental traits; twin studies and reports on eugenic progress in certain countries.

Mental deficiency or oligophrenia was restricted to two major questions, diagnosis and grading. Prof. Rudin, president, described the distinction made in Germany between oligophrenia as a psychiatric condition and what his school describes as normal stupidity. Prof. R. J. A. Berry gave an account of his long researches, and submitted the theory that mental defect can best be described as failure of development of the central nervous system; a condition which as such passes by indistinguishable grades from a pre-embryonic type in brain and cortex development to something which can best be characterised as less than the highest development known. He finds somatic and functional characters corresponding biologically to the various grades of lack of neural development. Dr. Rudolf, of Brentley Colony, Bristol, gave a lucid explanation of the way in which legislation has governed both the terminology and method of certification of mental deficiency in Great Britain.

A number of research workers in this field were present; amongst others, Dr. Wildenskow and Dr. Jens Smith, Denmark, Prof. Maier and Dr. Brugger, Switzerland, and Dr. Tietze and Dr. Hamburger, Austria. It would appear that legislation in both Germany and Great Britain has to some extent controlled the purely medico-biological treatment of the question. Denmark, with complete legislative control, has avoided this pitfall; the Danish psychiatrists, frankly admitting that an arbitrary line is drawn, below which lack of intelligence is regarded as warranting social control. Several speakers urged the evolutionary importance of this outlook; it might be hoped that, generation by generation, the point of poor development might be slightly raised if and as the average intelligence of the population rises progressively. Time did not allow of a full discussion on grading, but the only comparable base line still appears to be the Binet-Simon tests. A comparative study is urgently required.

The second day began with a study of psychometry. Dr. Mjoen opening with a demonstration of his methods of testing musical ability. The demonstration of five of his twenty different tests created so much interest that discussion ran through the whole morning, concentrating mainly on the degree to which training would affect test of performance. Dr. Mjoen gave evidence from re-tests, proving that certain of the most diagnostic factors remained unchanged.

Prof. C. Spearman gave a lucid exposition of his analysis of intelligence into a general and special factors, and asked for help in the attempt which is being made both by national committees and by a committee of the International Federation of Eugenic Organisations to bring greater order and clarity into methods of psychological measurement.

Dr. Steggerda, who has just been appointed chairman of the International Federation of Eugenic Organisations Committee, gave an account of the difficulties of psychological studies of non-European races, from his own work amongst the Mayas in Yucatan, whites and negroes in Jamaica, Indians in Arizona and some other groups. Both he and Prof. Rodenwaldt stated that there can be no doubt of wide racial differences in mental faculty. For example, in music the tests satisfactory for Europeans would fail altogether to elicit the much finer discrimination common in the yellow races and negroes. It would appear that a careful and sympathetic study of the manner of life of any people should make it possible to eliminate those aspects of European tests, such as speed, which are wholly inapplicable in some other cultures. The afternoon was devoted to papers on twin studies introduced by Prof. Freiher von Verschuer of Berlin, the first problem to be tackled being methods of differentiation of identical and non-identical twins. From a study not yet published, he gave a chart showing the unreliability of judging from the chorion. In 52 cases with double chorea, 12 proved to be identical and 40 non-identical.

Reports on eugenic work occupied three sessions. Several of those charged with administration of the new German eugenic law had accepted the invitation of the Federation to give an account of the practical working of the new measures. Dr. Ruttke, directing popular education in protection of heredity, gave a clear outline of the whole policy, which may be briefly summarised as: (*a*) Unification of State control throughout the nation. (*b*) Removal of unemployment (shown to have disintegrating effects on the sense of parental responsibility and family life). (*c*) De-urbanisation, which removes large families with self-supporting parents and good family history to peasant holdings which will be entailed. (*d*) Revision of marriage laws, making marriages for social or economic ends liable to be annulled. (*e*) Creation of bureaux for advice on heredity and marriage. (*f*) Provision of loans for young persons of sound stock who desire to marry—a measure which goes hand in hand with the exclusion of women from those industries which can be served by unemployed men. (*g*) The sterilisation law. Dr. Ruttke explained that the exclusion of criminals from the operation of this last measure is in order to remove any sense of degradation being connected with the operation; both in the courts and by popular propaganda, the ideal is put forward which has made sterilisation successful in California, that the citizen who accepts the operation with a sense of responsibility for posterity merits the esteem of the community. In regard to compulsion, he stated the fact not so widely known that patients may accept institutional treatment of segregation if they prefer it to sterilisation. (*h*) The Danish plan (also largely used in Switzerland) of castration for habitual sex offenders has been enacted as obligatory, the objective being double, both the cure of the condition in the individual and the protection of society. This last point is not necessarily regarded as a eugenic measure.

Reports of growing work and increasing interest were given from every country represented. These will be published in full in the report which will appear in the autumn, and will be obtainable from the Secretariat, price 2*s*. 6*d*.

The Royal Society of New Zealand

SCIENTIFIC work in New Zealand, so far as research is concerned, has largely depended upon the organisation of the New Zealand Institute, which has now been honoured by the title of the Royal Society of New Zealand.

The New Zealand Institute Act was passed in 1867, and in March 1868 the body began to function. During the sixty-six years of its existence the Institute has encouraged workers in all branches of science and has published a large number of their researches. The first volume of its *Transactions* appeared in 1868, and annually (with one exception during the War) since that date the publication has been produced. It may truly be said that the whole set of sixty-four volumes contains an epitome of the research work in science that has been done in the Dominion.

The recognition of the value and importance of the scientific work of the members of the Institute by the grant of a Royal Charter is a matter that gives the greatest satisfaction to its members. It is perhaps only natural in such a country as New Zealand, where natural objects both animate and inanimate are in large part novel to people from Europe, that observational science would attract the greatest number of research workers. Actually it will be seen that articles on zoology, botany and geology have throughout filled a large proportion of its pages, now perhaps more than ever. Those whose work is in the sciences of chemistry and physics perhaps feel their remoteness from the centres of scientific life more acutely, and wish also to publish in journals which have a wider circulation than the *Transactions of the New Zealand Institute* could claim. Even so, it is a matter of great satisfaction to know that the first scientific research of Lord Rutherford appeared in its pages.

At the meeting of the Council of the Institute on May 16, the actual change took place. The meeting received a letter from the Governor General, Lord Bledisloe, to whose initiative and great assistance the actual grant of the charter is largely due (see NATURE of July 14, p. 59). His Excellency's letter, which aroused great enthusiasm at the meeting, included the following significant words : "To starve knowledge (and especially that clearly ascertained and systematised knowledge which we designate science) or to stint it of its due reward is to court national disaster. If science, in the inevitable evolution of human genius, has contributed to economic adversity, it is because it has been applied in part only to the solution of human problems, and certain it is that only by the further application of science in all its ramifications and by a far more generous and enlightened recognition of its beneficent potentialities by the world's rulers will effective remedies for current human disorders be found."

In the evening, Prof. R. Speight, professor of geology in Canterbury College, Christchurch and president of the Royal Society of New Zealand, delivered an address in which he summarised the work of the Institute in various branches of scientific inquiry. He discussed the standing of the Institute (now the Royal Society) in the scientific life of the country in the past and at the present time. Prof. Speight stated that in his opinion "the activity of the Society and the interest it shows in scientific matters had never been greater".

The Council of the Royal Society were the guests of the president, Dr. J. Henderson, and Council of the Philosophical Society of Wellington on the following day. Addresses were delivered by Dr. Turner, Prof. Burbidge and Dr. L. Cockayne, and excursions were made to institutions and localities of scientific interest in the afternoon. The occasion provided much opportunity for scientific conference and discussion.

Royal Photographic Society's Annual Exhibition

THE Royal Photographic Society's seventy-ninth annual exhibition was opened on September 7 and will remain open until October 6. The hours are from 10 a.m. to 9 p.m. on all weekdays except Tuesdays and Fridays, when the closing hour will be 6 p.m. Admission is free.

As usual, the main part of the exhibition is pictorial, yet there is a considerable amount of work of scientific interest. Trade exhibits of apparatus and materials have been given greater prominence than in most former years. Particularly noticeable are the various substandard cinematograph cameras and projectors, some of which are now obtainable with sound-recording and -reproducing equipment. The small hand camera, too, is to be seen in great variety with all its special accessory apparatus.

H. E. Edgerton and K. J. Germeshausen, of the Massachusetts Institute of Technology, show a series of instantaneous photographs of rapidly moving objects. The time taken for a single exposure in most of these is 1/75,000 of a second ; in one set of pictures, however, the exposure time was only 1/1,000,000 of a second. The vortices in the air from an electric fan, a textile spindle turning 10,000 times in a minute, and several other rapidly moving objects are shown apparently stationary.

Aerial photography is fairly well represented, and there is one photograph by H. Frederick Low entitled "Archæology from the Air" ; underlying ground conditions produce a variation in the appearance of a growing crop as seen from the air, which enables the outline of the original workings to be clearly mapped.

Mr. G. Aubourne Clarke, of Aberdeen, already well known for his studies of cloud formations, shows a fine series of photographs of clouds. For these he has been awarded the Hood Medal, which is given "in recognition of meritorious performance in any branch of photography".

In radiography, a very interesting development is shown by the Research Laboratories of the Eastman Kodak Company. Radiographs of small animals such as moths, beetles, etc. have been made by using exceptionally soft X-rays. These rays, known as 'Grenz rays', will not penetrate the wall of a normal X-ray tube, so that a special tube with a very thin window had to be constructed. Moreover, they record the texture of paper generally used for wrapping X-ray films, so the films had therefore to be enclosed in a special carrier, the front of which was made from a thin sheet of gelatine dyed to exclude visible and ultra-violet radiation. The tube itself

was excited at relatively low potentials between 2 and 10 kilovolts.

Other work with soft X-rays produced by an ordinary tube is shown by H. Flower and Messrs. Ilford Ltd. The structures of shells and flowers are thus illustrated.

From the very excellent Natural History Section mention may be made of an interesting series of photographs by H. Morrey Salmon illustrating the habits of the Manx shearwater. This bird comes to land only during the breeding season, when the colonies sometimes number thousands of pairs. On shore the birds move only by night. They nest in burrows which they share with rabbits. The nesting bird is said to remain underground during the hours of daylight, and is relieved by its mate at night. Some of the photographs were taken off Pembrokeshire at about 10.45 p.m. about midsummer at a distance of nearly two miles; others, taken by flashlight, were taken close to the birds.

An instructional exhibit by Messrs. Ilford Ltd. shows a 'working model' of the formation of halation circles on plates and films. Excellent examples of the influence of various backings in preventing halation are shown. Further exhibits by Ilford Ltd. in co-operation with Dr. Russell Reynolds show examples of cineradiographs of such subjects as the beating heart, moving joints, etc. The Cossor-Robertson cardiograph is demonstrated by Messrs. A. C. Cossor Ltd. and Ilford Ltd., together with typical cardiograms made on special photographic material manufactured by the latter firm.

Magnetic Materials at Radio Frequencies

FOR some years past it has been the practice of line communication engineers to make use of iron-cored inductance coils and transformers at speech frequencies and even at carrier frequencies up to 50,000 cycles per second. The cores of such coils were usually composed of iron or a magnetic alloy in the form of wire or of powder embedded in a suitable binding material. During the past year or so, the attention of those responsible for the design and production of wireless receivers has been directed to the possibility of using such magnetic cores in coils and transformers, the frequencies of operation of which may exceed one million cycles per second. It has been claimed that broadcasting receivers giving better performance in a smaller space can be designed by the use of such coils, on account of the facility in screening and the more effective coupling between the circuits which these coils afford.

A report*, recently published by the Radio Research Board, summarises existing knowledge, both theoretical and experimental, of the behaviour of magnetic materials at radio frequencies with the object of assisting those engaged in the application of these materials in the manner outlined above. The subject is surveyed in an approximately analytical manner intended to illustrate the individual properties, such as permeability, hysteresis and dielectric loss of the various materials examined; and, where the quantitative data permit, typical numerical values are assigned to these properties for various frequencies up to about 2,000 kilocycles per second. It appears that these electrical properties of ferromagnetic core materials may be expressed in terms of permeability and power-factor in a manner analogous to the use of permittivity and power-factor for dielectrics.

From the information summarised in this report, it is concluded that the effective permeability of magnetic powder compositions is necessarily low compared with that of the magnetic material, and that it depends mainly upon the size of the particles employed and the spacing between them, rather than upon the permeability of the magnetic constituent. It is probable, though not certain, that the greater part of the total radio frequency losses in composite magnetic materials is due to eddy-current formation and a consequent skin-effect in flux distribution. There are at present available a number of iron powder compositions in which, by sufficiently fine division of the magnetic material and provision of adequate particle insulation, the total losses are reduced to a value which gives an economic permeability of from 4 to 10 up to frequencies of about 2,000 kilocycles per second. It is not known to what extent the behaviour of such material is consistent with theory, nor is there any certain knowledge of the constitution of the losses. Further, it is concluded that there is no evidence indicating that the limit of improvement in such materials has yet been reached.

The useful lines of future investigation of the subject are clearly indicated in the report, which undoubtedly forms a clear and concise introduction to this field of research in radio frequency technique.

* Department of Scientific and Industrial Research. Radio Research. Special Report No. 14. "Magnetic Materials at Radio Frequencies, A Critical Survey of Present Knowledge." By F. M. Colebrook. (London: H.M. Stationery Office, 1934.) 6*d*. net.

Determination of the Molecular Weights of Colloids

IN the January issue of the *Berichte der deutschen chemischen Gesellschaft* Prof. H. Staudinger discusses the validity of the method of deducing the molecular weight of a colloid of high molecular complexity from observations of its *specific* viscosity. The author claims that this new method is applicable to the investigation of numerous complex naturally occurring substances such as cellulose and india-rubber, since many physical properties such as elasticity, ductility, solubility, etc., are functions of the length of the molecular chain. Older methods of determining molecular weights of complex molecules are more restricted in their application. Thus the cryoscopic methods give very low results in dilute solutions and in more concentrated solutions the relation between molecular weight and osmotic pressure is no longer simple. The diffusion method is only suitable for particles of spherical shape and can therefore not be applied to the long fibre-molecules of many natural colloids.

An earlier account of Prof. Staudinger's views is to be found in the *Transactions of the Faraday Society* of January 1933, and the main object of this recent paper is to examine certain experimental evidence

which seemed at that time to be in conflict with the viscosity law. No simple relation between molecular weight and viscosity was discovered until measurements were made upon synthetic colloids of high complexity, and there has been reluctance to depart from the older interpretation of viscosity by micelle-formation, since viscosity is not always a simple function of the length of the molecular chain. This is particularly true of heteropolar colloids, for example, albumen, the viscosity of which is largely due to its tendency to polymerise to macro-molecules.

Prof. Staudinger deals in this paper with certain conflicting evidence and he finds a reasonable explanation. He contends that the law is applicable over a very wide range of colloidal substances. It is valid for molecules ranging in length from 10–20 A. to 1450 A. and he claims that it is reasonable therefore to deduce values by extrapolation for the molecular weight of cellulose with a molecular length of 4000–5000 A.

The main criticisms which have been directed against these views appear to have been based upon measurements of solutions of technical samples of cellulose acetate and of certain complex acids. In the former case, the solutions were not sufficiently dilute to allow of complete molecular mobility—in fact gels had been employed in some cases. By applying suitable correction factors the results have been brought into line with the viscosity law. In the case of the complex acids, it is contended that unless the molecular length exceeds about 600 A., there is a decided tendency for the molecules to form complex aggregates. This is sufficient to account for deviations from the viscosity law.

University and Educational Intelligence

OXFORD.—Mrs. Mary Jane Williams, of Whitley, Surrey, who died on July 24, has left £30,000 to the University, to be expended by the Board of the Faculty of Medicine as it deems best for the promotion of Oxford medical education.

A LIST of the public lectures to be delivered at the University of Leeds and the Philosophical Hall, Park Row, Leeds, during the session 1934–35 has recently been published by the University. Among the lecturers will be Lord Rutherford, Prof. C. Burt, Prof. A. Harden, Prof. W. J. Tullock, Prof. B. Melvill Jones, Prof. F. A. E. Crew, Prof. Hans Driesch, Prof. R. W. Whytlaw-Gray, Prof. R. Whiddington and Sir G. Elliot Smith.

CITIZENSHIP as an objective of university education is the theme of an article by Prof. Ashbaugh of Miami University, Ohio, published in *School and Society* of February 3. Like many other articles that have appeared recently in the same journal it testifies to the "amazing and universal increase", to quote from President Roosevelt's review of his first year of office, "in the intelligent interest which the people of the United States are taking in the whole subject of government." The writer gives particulars of two schemes whereby university administrators have attempted to give effect to the ideal of developing socially efficient citizens. One, launched a few years ago at the University of Toledo, comprised a variety of courses spread over the first two undergraduate years under designations such as "Principles of Human Behaviour", "College Life", "Modern Literature", "Problems of Modern State and City Governments", "Chemistry of Everyday Life", "Modern Logic". This attempt failed because "the conservative faculty insisted upon the prerogative of their traditional departmental organization". The other is in course of elaboration in the writer's own department (the School of Education) of Miami University. It stresses the necessity for courses which will not merely impart information but also include genuine training calculated to implant appropriate ideals and attitudes and to strengthen them by actual practice in the workshop of the world. A similar concern for equipping the student for worthily playing his part in present-day community life has marked in some instances the development of the 'junior college' movement in the United States, but too often the pressure of the minority definitely bound for a full and formal university curriculum has obscured the ideal of adquate training for the many whose formal education does not extend more than a year or two beyond the high school.

SCIENCE curricula in the universities are discussed in an article by Prof. L. N. G. Filon in a recent issue of the *Universities Review*. The enormous extension in the last thirty years of the boundaries of knowledge has invalidated some of the assumptions on which was based the existing organisation of undergraduate studies in the science faculties and has thus given rise to problems calling urgently for solution. The article outlines a tentative scheme, involving on one hand the raising of the level of entrance into the university to the Higher Certificate stage and, on the other hand, an abandonment of "the research fetish"—a postgraduate degree (M.Sc. ?) being used to mark the completion of a course of study extending over at least one year to meet the needs of those concerned to consolidate their gains—to fill the gaps, increasingly inevitable, in the knowledge acquired in undergraduate courses. These courses would be, during the first two years of university study, in three subjects, the course in each subject being the same for all students. This work would be tested by an examination corresponding roughly in standard and extent to the present pass or general degree examination, but conducted so as to be a very severe and searching test of minimum knowledge, and including a compulsory paper on the English language, *not* merely an essay. The third year's work would be adjusted to the students' varying capacities and prospective careers: (*a*) those who failed in the minimum knowledge test would be allowed to prepare for a second attempt at the end of their third year; (*b*) those intent on a broadly cultural equipment would have the option of taking a course in some chosen field lying wholly or partially outside those to which the first two years were devoted, for example, education, history of science, border-line sciences of their group, social sciences and so on; (*c*) intending specialists would prepare for a special degree examination on the lines of those now in use, but with no subsidiary subject; and (*d*) those wishing to carry further their selected scientific studies without aspiring to be specialists would take a course for a 'general' honours degree. The successful passing of the third year examination would be marked by the award of a pass degree to candidates of class (*a*) and an honours degree to the others.

Science News a Century Ago

Imperial Academy of Sciences, Russia

The Imperial Academy of Sciences in Russia has published a clause of the will of an artillery officer, Count Araktsehejen, by which the testator established a fund of 50,000 roubles for the author of the best History of the reign of the Emperor Alexander. The work is not to be written until 100 years after that monarch's death, that is, in 1925. The author must be a Russian subject. The money will remain 93 years in the bank where it will accumulate interest. Ten years before the time appointed, that is, in 1915, the Academy of Sciences of St. Petersburgh, will announce that competition is open, and that the prize will be awarded in 1925. Of the sum available one quarter will be devoted to the publication of the work, and the successful author will receive the remainder. (*Gentleman's Magazine*, Sept. 1834.)

Trials of S.S. *Nile*

The *Times* of September 16, 1834, recorded the trials of the S.S. *Nile*, which had been built for the Pasha of Egypt and was referred to as the largest steam vessel that had hitherto been constructed in Great Britain or probably in any country. She was 183 ft. 2 in. in length, 32 ft. 8 in. beam, 21 ft. 9 in. deep in the engine room, and drew about 14 ft. of water. She was more than 900 tons weight and was driven by engines by Boulton and Watt of 220 nominal horse-power. "The trial," said the *Times*, "was successful in every respect; her speed as ascertained at the measured mile below Northfleet, having exceeded from $\frac{1}{10}$ to $\frac{1}{8}$ that of our own Government Steam-ships of equal power. . . . The primary object of this vessel is said to be to tow the ships of the line belonging to the Pasha in and out of the harbour of Alexandria, but she is capable of being converted to purposes of war in case of emergency." The *Nile* appears to have been built at Limehouse and launched under the name of *Pasha* on May 7, 1834.

Ascent of Mont Blanc

"Dr. Martin Barry and six guides left the Priory at Chamouni at half-past eight in the morning of the 16th September, and at noon entered upon the snow, crossed the Boissons Glacier and saw some chamois. The fissures were found to be greatly widened from the lateness of the season [the ascent being by a week the latest that had been made]. The dangers and difficulties were thus much augmented, large masses of ice were met with over some of which it was necessary to climb, and the peril was particularly great in attaining the rock called the Grand Mulet, where the party slept. Next morning, they proceeded attached as they walked, two or three together with cords and cautiously trying every step with their batons. . . . They breakfasted on the Grand Plateau and saw the spot where the avalanche occurred during Dr. Hamel's attempt in 1820. . . . On approaching the summit, so great was the exhaustion from the diminished density of the air, that only a few steps could be taken at a time, and the doctor felt faintness and languor, but at length, his labours were repaid, and he stood on the highest point. He remained on the top an hour and a quarter." (*Annual Register*, 1834.)

Societies and Academies

PARIS

Academy of Sciences, July 23 (*C.R.*, 199, 249–328). CH. PORCHER, HENRI VOLKRINGER and MLLE. JEANNE BRIGANDO: Contribution to the study of casein. Detailed study of the absorption spectra of casein and paracasein. EDOUARD CHATTON and MLLE. BERTHE BIECHELER: The Coccidinidæ, dinoflagellate coccidiomorph parasites of Dinoflagellates and the phylum of the Phytodinozoa. MARC KRASNER: The first case of Fermat's theorem. A. GELFOND: Some new results in the theory of transcendental numbers. JEAN MASCART: The perihelia of the minor planets. HENRI MINEUR and HENRI CAMICHEL: The variations of the ellipsoid of velocities in the galactic plane. HANS EKSTEIN and MICHEL MAGAT: Remarks on the forces of Van der Waals in liquid mercury and in the molecule Hg_2. GEORGES DECHÊNE: The Johnsen-Rabbeck effect. The author gives a new explanation of this phenomenon which also affords an explanation of an experiment described by Toby. DANIEL BODROUX and RENÉ RIVAULT: Some attempts to photograph the television emissions from London and a local station on short waves. Description of the apparatus used for the reception with reproductions of the photographs obtained. ANTOINE GOLDET and ARCADIUS PIEKARA: The thermal variation of the magnetic double refraction of mixtures. The case of a mixture presenting a critical point. L. COLOMBIER: The electrolytic potential of nickel. Values varying between $-0\cdot138$ and $-0\cdot621$ have been published for this constant. The author discusses the possible causes of this variation and describes experiments in which the errors due to gases fixed on the surface of the nickel and to the increase of activity due to the presence of hydrogen are eliminated as far as possible. The values found fall between $-0\cdot225$ and $-0\cdot23$. ANTOINE MARSAT: The modes of graphical representation of the distribution of the flux emitted by a light source. JEAN PAUL MATHIEU: The optical activity and solubility of some cobaltammines. PRIVAULT: Weak lines of the K series of the elements from chromium to copper. The fluorescence lines of some compounds of these elements. F. HAMMEL: The X-ray spectra of manganese sulphate and its hydrates. Five specimens of the monohydrate of manganese sulphate prepared in different ways give the same spectrum: nothing in the spectra of the five specimens suggests a difference of structure. These results are not in agreement with those of Krepelka and Rejha. I. ZLOTOWSKI: The heat of the γ-radiation of radium. An application of the adiabatic microcalorimeter of Swietoslawski and Dorabialska. MARIUS BRIAND, PAUL DUMANOIS and PAUL LAFFITTE: The influence of temperature on the limits of inflammability of some combustible vapours either pure or in admixture. Data are given for isopentane, acetone, methyl, ethyl and butyl alcohols and some binary and ternary mixtures. MME. ALMA DOBRY: The osmotic pressure of polymerised substances. Utilising an apparatus capable of measuring with sufficient accuracy osmotic pressures down to $1\cdot5$ mm. of water, the limiting value of the ratio pressure to concentration can be determined. These limiting values are independent of the solvent. The molecular weight of nitrocellulose thus obtained is 110,000. MARCEL CHATELET: Some reactions of divalent chromium

chloride. Compounds of chromous chloride with pyridine and with ammonia. HENRI VOLKRINGER, ARAKEL TCHAKIRIAN and MME. MARIE FREYMANN: The Raman spectra of the metallochloroforms in relation with their structure. Comparison of the Raman spectra of chloroform, silicochloroform, germanochloroform and chlorstannic acid. The correspondences show that these four compounds have analogous structures. MLLE. BLANCHE GREDY: The (Raman) spectra of some acetylene compounds of the cyclane series. LÉON PALFRAY and MLLE. SUZANNE TALLARD: The influence of the free acidity on the determination of aldehydes and ketones by hydroxylamine hydrochloride. The amounts of aldehyde or ketone found by the hydroxylamine method are affected by the presence of organic acids, but this error can be minimised by the use of bromophenol blue as indicator. RENÉ EMILE BREUIL: Complex compounds of ferrous salts with ethylenediamine and trimethylenediamine. CAM. LEFÈVRE and CH. DESGREZ: Contribution to the study of the aromatic sulphides. F. LINK: The illumination of the higher atmosphere and the twilight tables of Jean Lugeon. J. LACOSTE and J. P. ROTHÉ: Earthquakes in France in 1930–33. ANDRÉ DAUPHINÉ: The mode of formation of the pecto-cellulosic membrane. P. MARTENS: New observations on the cuticle of floral epiderms. MAURICE PIETTRE: Concerning the protein equilibrium of the blood serum. SÉBASTIEN SABETAY and MME. HERMINE SABETAY: A colour reaction of the azulenogen sesquiterpenes. A. LEPAPE and R. TRANNOY: The influence of radium on the cultural yields of some plants. J. E. ABELOUS and R. ARGAUD: The formation of adrenaline in the suprarenal capsule. Combined or virtual adrenaline and free adrenaline. PAUL MATHIAS and MME. MARGUERITE BOUAT: The development of the egg of *Branchipus stagnalis*, a phyllopod crustacean. MLLE. A. TÉTRY: Description of a French species of the genus *Pelodrilus*. W. KOPACZEWSKI: Seric lactogelification considered as an index of neoformation. LÉON BINET and MLLE. MADELEINE BOCHET: An arrangement for artificial respiration in man.

CRACOW

Polish Academy of Science and Letters, June 4. S. K. ZAREMBA: The trend of the characteristics of the differential equation $Y(x,y)dx - X(x,y)dy = 0$ in the neighbourhood of an isolated singular point (1 and 2). MLLE. B. TWAROWSKA: The extinction of the fluorescence of a solution of biacene in *p*-dichlorbenzene at $-180°$ C. The loss of fluorescence is explained as being due to the solid solution of mixed crystals changing into a mixture of pure crystals of biacene and of *p*-dichlorbenzene. L. MARCHLEWSKI and WL. GOSLAWSKI: The absorption of the ultraviolet rays by certain organic substances (38). Study of the optical properties of 16 substances of the lignin type. K. SMOLENSKI and A. ZLOTNIK: The reduction of galacturonic acid and of the methyl ether of methyl-galacturonide. K. SMOLENSKI and S. KOWALEWSKI: The pyrogenetic decomposition of ethyl alcohol. Studies on the substances produced by heating ethyl alcohol at high temperatures (400°–500° C.) and under high pressures. K. KONIOR: The geology of the neighbourhood of Przemysl. A. BURSA: *Hydrurus foetidus* in the Polish Tatra. Ecology and morphology (1). W. VORBRODT: The presence of tyrosine in the protein substances of *Aspergillus* (*Aspergillus niger*). Crystalline tyrosine has been prepared from the mycelium of this mould. ST. JASNOWSKI: The inheritance of sterility of the base and summit of the ear of *Triticum vulgare*. F. ROGOZINSKI and ZB. GLOWCZYNSKI: Experimental rickets (6). The influence of magnesium salts. From the experiments described it would appear that an excess of magnesium salts added to the food acts differently according to the proportions of calcium, magnesium and phosphorus in the food. J. FILHOL: The embryology and development of *Lamproglena pulchella*. B. JALOWY: The origin and rôle of the Langerhans cells in tactile hairs.

GENEVA

Society of Physics and Natural History, May 17. P. ROSSIER: Comparison of the atmospheric extinction in the ultra-violet and the visible spectrum. The study of the extremities of stellar spectrograms shows that the importance of the ultra-violet diminishes in relation to the visible spectrum in proportion as the zenithal distance of the star observed increases. For comparisons of magnitudes made only in ultra-violet light, the extinction coefficient appears much larger than in visible light. E. MOLLY: Petrographic studies in Ethiopia. (2) Observations on the basalt rocks of Abyssinia. (3) Observations on the alkaline rocks of Abyssinia. G. TIERCY: The distribution of the temperatures in the interior of the stars. This note defines the connexion that may be established between the solution by polytropic equilibrium valid in the central part of the star and the approximate solution drawn from the theory of the radiation equilibrium, so far as the peripheral part is concerned. G. TIERCY and A. GROSREY: The width of photographic spectra for stars of the $K0$ type. A study of the variation of the width of a spectrum obtained with the Schaer-Boulenger instrument as a function of the magnitude of the star and time of exposure.

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 2, No. 3). N. S. KOSHLIAKOV: On a certain definite integral connected with the cylindrical function $Ju(X)$. V. FESENKOV: Influence of an error in the installation of an equatorial on the deplacement of the images of stars on a photographic plate. I. TAMM: The theory of elementary particles. D. D. IVANENKO: Is the transmutation of hydrogen into neutron possible? A negative conclusion is reached, which is analogous to that drawn by Sommerfeld from his fine structure formula. J. A. KRUTKOV: A note on the rolling of a ship. Mathematical expression of the movements involved is offered. S. LIFSHITZ: Apparent duration unit of sound perception. The apparent duration of a constant 1,000 *v/s* tone sounding during one second with a loudness of 1 db. was taken as the unit. N. SHISHAKOV and L. TATARINOVA: Determination of crystal lattice constants by electron diffraction. The use of a convex specimen is a much simpler method than that introduced by G. P. Thomson in which a flat ground specimen is used (see also NATURE, 133, 686, May 5, 1934). V. ALTBERG: Bottom ice. A brief summary of the work done at the State Hydrological Institute. A. FRUMKIN and A. SHLYGIN: The platinum electrode. Quantitative studies on the electric energy necessary to communicate to the electrode a certain potential. I. I. CHERNIJAEV and A. M. RUBINSTEIN: On Stromholm's triaminosulphite. On oxidising triaminosulphite $(NH_3)_3SO_3Pt$, the residue SO_3 is oxidised first, and simultaneously

the trans-ammonia is split off. Owing to this splitting, the transition from triaminosulphite to triaminochloride is impossible. V. S. SADIKOV and V. A. VADOVA: Alcoholysis of serum albumin. On heating serum albumin in an autoclave at 180° for six hours with 99·5 per cent ethyl alcohol, 99 per cent of the albumin was liquified. Z. S. KATZNELSON: Mesenchymatic development of the striated muscles in Amphibia. Striated muscles of the extremities, gills, ventral wall and head develop by a local differentiation of the mesenchyme. Stages in their development are described. A. KHARIT and A. KOSTIN: The oxidation and reduction processes in working muscle. (4) Oxides and suboxides of iron in muscle during work. A muscle before and during stimulation contains organic oxides of iron which are transformed into suboxides. During work, this process greatly increases. I. J. SYROVATSKII: Biology of some Black Sea fishes. Notes on the seasons of reproduction in *Scomber scombrus*, L., *Sarda sarda*, L., *Caspialosa pontica*, Eichw., and *Spratella sprattus phalerica*, Risso. G. V. NIKOLSKIJ: Materials on the geographical variability of *Capoetobrama kuschakewitschi*, Kessl. (Pisces, Cypronidæ). Description of a new sub-species from eastern Turkestan. A. I. KURENTSOV: Contribution to the problem of the origin of the high-mountain fauna of the South Ussuri region. The ancient faunistic element is composed of the relics of the palæogenic fauna which have survived the Miocene glaciation on the spot. More recent elements belong to the palæarctic fauna which migrated south in the Quaternary period.

MELBOURNE

Royal Society of Victoria, May 10. C. W. WARK: An investigation into the influence of sulphate of ammonia on stubble-sown oat crops in Victoria. Field trials were established at Bannockburn and at Buangor. Sulphate of ammonia was applied at the rates of ¾ cwt. and 1½ cwt. per acre. The application of these dressings caused an increase in the nitrate content of the soil in June–August, an increase in the average number of tillers per plant in spring, and a marked increase in the number of ears and grains produced at harvest. The percentages of nitrogen in the grain and in the straw were not affected. MISS F. J. HALSEY: A disease of cauliflowers in Victoria, Australia (*Gloeosporium concentricum*, (Grev.) Berk. and Br.). The disease is prevalent in Victoria, damaging the leaves, and also the inflorescences. The most characteristic symptom is the presence of minute white fluffy clusters of spores on both surfaces of the leaves. History connected with the fungus is discussed and as a result of this, together with the evidence disclosed by study of the pathogen on the host and in pure culture, it is named *Gloeosporium concentricum*, (Grev.) Berk. and Br. Spores from the host measure on the average $11 \cdot 9 \times 3\ \mu$ and are produced in subcuticular acervuli. The conidiophores are short and unbranched, constricting off at their apices, in succession, the cylindrical, one-celled, hyaline conidia. The pathogen was obtained in pure culture and growth on various media was studied. The conidia are formed at any point throughout the culture; in discrete sporing areas (sporodochia); and in pseudopycnidia. Germinating spores possess a median septum. Inoculation experiments with seedling cauliflowers proved successful. The effect on spore germination of varying *p*H values was studied. Germination percentage fell sharply, especially on the acid side.

Forthcoming Events

WOMEN'S ENGINEERING SOCIETY, September 21–23. Twelfth annual conference to be held at Norwich. Miss E. M. Kennedy: President.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX, September 21–24. Eleventh Annual Conference to be held at Somerville College, Oxford.

Sir Richard Gregory: "Science in the Public Press" (Presidential Address.)

Official Publications Received

GREAT BRITAIN AND IRELAND

Report of the Progress of the Ordnance Survey for the Financial Year 1st April 1933 to 31st March 1934. Pp. 14+11 plates. (London: H.M. Stationery Office.) 3*s*. net.

General Index to the Monthly Notices of the Royal Astronomical Society. Vols. 71–91, 1911–1931. Pp. v+168. (London: Royal Astronomical Society.) 5*s*.

Sea-Fish Commission for the United Kingdom. First Report: The Herring Industry. (Cmd. 4677.) Pp. 51. (London: H.M. Stationery Office.) 9*d*. net.

Memoirs of the Cotton Research Station, Trinidad. Series A: Genetics. No. 8: Further Experiments on the Inheritance of Chlorophyll Deficiency in New World Cottons. By S. C. Harland. Pp. 181–195. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1537 (Strut. 128): Method of Representing Spar Tests. By H. R. Fisher. Pp. 28+11 plates. (London: H.M. Stationery Office.) 1*s*. 9*d*. net.

East London College (University of London). Calendar, Session 1934-1935. Pp. 237. (London.) 1*s*.

Proceedings of the Royal Irish Academy. Vol. 42, Section B, No. 3: The Occurrence and Development of *Euphausia krohnii* off the South-West Coast of Ireland. By Winifred E. Frost. Pp. 17–40. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 10: The Approximate Determination of the Vibration of Beams and the Whirling of Shafts. By Dr. H. H. Jeffcott. Pp. 87–112. 2*s*. 6*d*. Vol. 21 (N.S.), No. 12: The Influence of the Stage of Lactation on Fat Estimations by the Gerber Method. By J. Lyons and M. O'Shea. Pp. 123–131. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

British Association for the Advancement of Science. A Scientific Survey of Aberdeen and District. Prepared for the Aberdeen Meeting, 1934. By various Authors. Pp. 123. (London: British Association.)

OTHER COUNTRIES

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 86. The Buckler Dory Descriptions of Three New Fishes from off New Jersey and Florida. By Henry W. Fowler. Pp. 353–361. (Philadelphia.)

Conseil Permanent International pour l'Exploration de la Mer. Faune ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. No. 15. 24 plates+text. 4.00 kr. Rapports et procès verbaux des réunions. Vol. 88: Scientific Report of the North-Eastern Area Committee, 1934. Published by Oscar Sund. Pp. iii+102. 4.00 kr. Vol. 89: 2ème partie, Rapport administratif (1933–1934). Pp. 76. 3.50 kr. Vol. 89: 3ème partie, Appendices (1933–1934). Pp. 103. 5.00 kr. Vol. 90: Size-Limits for Fish and Regulations of the Meshes of Fishing Nets; Reports of the Proceedings of the Special Biological Meeting held on June 4th and 8th, 1934, at Copenhagen. Pp. xv+61. 3.00 kr. (Copenhague: Andr. Fred. Høst et fils.)

U.S. Department of Agriculture. Technical Bulletin No. 404: The External Anatomy of the Red Date Scale, *Phœnicococcus marlatti* Cockerell, and its Allies. By F. S. Stickney. Pp. 163. (Washington, D.C.: Government Printing Office.) 15 cents.

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 1: January, February, March, 1934. By Ernest A. Hodgson. Pp. 24. (Ottawa: King's Printer.) 25 cents.

The Indian Central Cotton Committee. Note on the Improvement of Cotton in Sind. Pp. 8. (Bombay: Indian Central Cotton Committee.)

Trinidad and Tobago: Forest Department. Administration Report of the Conservator for the Year 1933. Pp. 22. (Trinidad: Government Printing Office.) 10*d*.

Rubber Research Institute of Malaya. Annual Report, 1933. Pp. ii+163. (Kuala Lumpur.) 1 dollar.

Memoirs of the Geological Survey of India. Palaeontologia Indica, New Series, Vol. 20, Memoir No. 4: The Jurassic and Cretaceous Ammonites and Belemnites of the Attock District. By Dr. L. F. Spath. Pp. iv+39+6 plates. (Calcutta: Geological Survey; Delhi: Manager of Publications.) 4 rupees; 6*s*. 9*d*.

CATALOGUES

Bismostab Injection of Bismuth B.P. Pp. iv+42. (Nottingham: Boots Pure Drug Co., Ltd.)

Apparatus for Micro-Chemical Analysis according to Pregl and other Workers. (List No. 103.) Pp. 16. Rubber Testing: Experimental and Research Equipment. (List No. 104.) Pp. 60. (London: A. Gallenkamp and Co., Ltd.)

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Peace and War in the Air

IT is one of the most tragic facts in the recent development of science that the conquest of the air, which on all grounds should have worked towards the unification of the world and the harmony of mankind, has actually become one of our most threatening dangers. No branch of science is more completely international in its history than aeronautics. Cayley, Lilienthal, the Wrights and Bleriot are a few names out of hundreds, all belonging to different nations, all having contributed something essential to what should be a common good. The air itself is obviously international, having a common constitution, enveloping and moving over us all, and having no possible fixed boundaries or divisions. Nothing, except the sunlight and rays from space, seems so clearly devised by Nature to keep us all together. Yet this heaven-sent unifier is finding in practice almost every possible man-made obstacle to the carrying out of its proper work. Men have used it almost from the first for what is simply murder, the killing, by the easiest wholesale way, of non-combatants—women and children—in the course of war. Moreover, though this practice is solemnly banned at international conferences and by the League of Nations, all the nations go on making their fighting planes so that they may do their destructive work more and more expeditiously. Now it is said that, even in the sphere of civil aviation, so many difficulties are put in the way of co-operation that an international authority is out of the question. In spite of the progress of science, the League of Nations and the extreme economic needs of the world, it is being made more difficult to secure a free passage through the air than free passage at sea.

There is this month, at The Hague, a conference of the International Air Traffic Association, and Mr. G. E. Woods-Humphery, the managing director of Imperial Airways, conscious of the nationalist animus which has been blown into the subject, writes in advance a very moderate article (in *Shell Aviation News*) trying to do a little deflation. Everyone must wish him well, but it is hard indeed to imitate the restraint of his language in speaking of the perversion of a good thing to bad ends by unrestrained rivalry, suspicion and ill-will.

Mr. Woods-Humphery begins by saying that the future of civilisation depends upon moderating this purely national spirit, and points out that the

extreme nationalism of the last decade "has undoubtedly militated against the growth of air transport". Each national reservation or restriction leads to a corresponding reprisal. He sees two ways by which "free passage in time of peace", which is his very modest desideratum, might be secured. The first is the internationalisation of air transport. He dismisses this as a course "much beloved by theorists", but to those having any knowledge of the matter "frankly an impossibility".

It is on this point that one would wish to reason a little with Mr. Woods-Humphery and, if possible, make him a little more hopeful. No one would dream of an international authority being forthwith, or indeed at any time, constituted to take over either the ownership, or the complete control, of the air lines of the world. But in fact, as history shows, that is not how things work. There are plenty of precedents. Our national railway system is one; the International Postal Union is another. In the first, the ownership of the lines rests—with little profit to them at the moment—in the hands of private owners. The State has, however, always retained a general control, and, from the first, passed Acts of Parliament regulating fares, the building of new lines, the protection of travellers against risk, etc. On the whole, while making allowance for the present depression which affects us all, this mixed system must be said to have worked well. British railways appear to serve the country as well—most people would say better—than foreign systems owned and entirely controlled by the State.

The International Postal Union, which has its offices in Berne, and grew up in the middle of the last century, affords an even closer analogy, of how an efficient system may be achieved by methods of gradualness, when different countries are concerned, and without infringing the possessory and self-governing rights of each. In each country an internal system of posts was evolved, mostly in the eighteenth and nineteenth centuries, as national organisations were improved. With us, the most important forward steps were taken in the forties of last century through the intelligent foresight of Sir Rowland Hill. The advantages were so great that the example quickly spread, and from the middle of the century onwards communications began to be set up with the similar organisations abroad on questions of common interest. From 1875, a quinquennial International Postal Congress was held, pledged to uniform actions on such matters as rates, the transit of letters, etc. This body has permanent offices and its workings are so satisfactory that no one notices them. It should be studied, however, as an example of what can be done with perfect ease when men once recognise the necessity and apply their intelligence with general goodwill to securing it. No one thinks of the international post as a means by which packets of poison-germs could be transmitted to unloved neighbours.

The question of international air transport is more complicated because from the first it has been contemplated that machines used ordinarily for civil purposes should be convertible into war-planes, if need required. It seems that nothing can prevent this, if the devil drives. No written or spoken undertakings would bind the transgressors in time of war. The only feasible way, therefore, of approaching the problem is to build up, seriatim, a system of air transport for pacific purposes, so useful, well fitted together and generally accepted, that it would appear a monstrous perversion of it to murder people from the air. Mr. Woods-Humphery in his article mentions one obvious point to be secured by the earliest agreement possible. We must obtain for aircraft, proceeding on their "lawful occasions", similar facilities as are available for ships at sea. "The latter are free to follow any course which they desire, outside territorial waters" (a quite narrow limit), and are "allowed in territorial waters to pass unhindered to the port of their choice". This seems modest enough, but Mr. Woods-Humphery is willing to accept even a smaller instalment. "Possibly a temporary way (although it is only palliative) to meet the present difficulties would be to allow free passage to foreign air services for the carriage of their own national 'through' traffic."

It is well that attention has been directed to these extraordinary and pestilential obstacles, and that the *Times* recently gave full publicity to them. To obtain, however, so small and obvious a concession must be regarded only a first step to an agreed code of international civil aviation similar to that of the International Postal Union. Possibly the air traffic conference at The Hague will prove the germ of an international body to which the registration and carrying out of the necessary agreements will be entrusted. Other urgent points on which agreement is necessary, in order to secure an efficient and reasonably cheap air service, are the elimination of unnecessarily competing lines. Several of these are to be found in northern countries, notably in Scandinavia. It

should not be difficult to arrange compromises in such cases, which it is to the interest of all Governments to support, as subsidies will only become unnecessary as air transport becomes more popular, and it can only become more popular as those conducting it make their services more convenient by dovetailing the various lines, issuing joint timetables, aiming only at peaceful commercial and scientific purposes, with no *arrière-pensée* of war.

There is much to be done, and science has as great an interest in the matter as international peace. At the time of writing, we have not yet even been assured that the question of the planes of England being allowed to use the airways of France has been satisfactorily settled. It is a pity that flying and the air-post being at present rather a luxury of the rich, it is impossible to arouse the same popular interest in the matter as is now felt in other pacific questions. But it is none the less important for the future, and advance can be made in Mr. Woods-Humphery's spirit, but with more confidence and larger possibilities in mind and a larger objective in view. Science has provided in the aeroplane one of the most potent agents for peace and progress that the world possesses. It must be for the common sense of mankind to use it for its natural end.

F. S. M.

Periodicals and Reference

A World List of Scientific Periodicals published in the Years 1900–1933. Second edition. Pp. xiv+780. (London: Oxford University Press, 1934.) 63*s*.

WITH its first issue, 1925–27, the "World List" took rank as a notable addition to library resource. It essayed to catalogue the scientific periodicals of the world current at commencement of this century and thence onward to 1921. To each of the periodicals (more than 25,000) of its list it assigned a reference-title individually distinctive. Further, for each of those traceable to any of 150 given representative libraries in the British Isles, the list stated by which of those libraries the periodical was filed. This census of extant periodicals, and of the British intake of them, was undertaken at a significant time. Want of it was being acutely felt. A post-War world in being was making departures fresh. In various directions the recovery of scientific production was almost feverish. Renascent nations newly risen rejoiced to show their virility and culture by contributing to science through channels natively and linguistically their own. However desirable might be a full inventory of all this activity, it was far from easily compassed. It meant search at sources emanating the world over. Their number proved to be yet greater than had been thought. Nevertheless the difficulties were overcome, and the results justified their undertaking.

Still the stream of scientific publication, far from abating, increases. Especially so its spate of periodicals. These, at recurrent short intervals, as they do, supplying so to say red-hot instalments of science in the making, possess ever wider public appeal and use. More than 5,000 new periodicals have arisen since the "World List's" census twelve years ago. A fresh edition of the List has therefore become urgent. For the production of this, now welcomely before us, the same competent and devoted hands which provided the original have happily, with little change, been available once more. Sir Peter Chalmers Mitchell as chairman, a council of management, an advisory committee, and as editor, Mr. W. A. Smith, of the British Museum, have accomplished the revision and expansion needed. Their public-spirited service, costly in time and labour, has been rendered gratuitously, as though with a generous gesture *labor ipse voluptas* for the end in view.

The present edition is issued as a single volume. It has the improvement that for each periodical, all the given data are brought together in one omnibus entry, already in so far collated for the reader. The total of titles listed is some 10,000 more than in the former issue. Periodicals beginning since that issue are included to end of 1933. In supplying an individually distinctive abbreviated reference-title to each of the 35,000 periodicals listed, the International Code of Abbreviations for Titles of Periodicals (Paris 1930) has been followed. This has not entailed much change from the abbreviations used in the previous edition because the International Code is largely based on the practice of the original edition of the "World List". A standard abbreviation-title of international sanction and use for each periodical has been much wanted. The "World List" now, even more fully than before, provides this international desideratum. A writer of a scientific paper or review can here find it ready to his hand, and editorial management can therefore more stringently insist on its use. Neglect of it confuses citation. The need for it is shown by the coexistence, as given in the "World List" before us, of above 2,000 separate current *Bulletins*, besides *Bultens*, *Bulletinos*, *Bulletinals*, etc., crowding alphabetically toward one like initial abbreviation. *Journals*, too, form a great group scarcely less prone to ambiguity in referencing. The standard

reference-title, besides avoiding ambiguity, gains brevity because it can omit, except in a few cases, the place of imprint. A helpful usage is for each periodical itself to bear on its cover its standard abbreviated reference-title. This is done by publications of the Wistar Institute, the *Journal of Physiology* and some few others.

In this new "World List" the distribution of scientific periodicals as regards their location in the British Isles is traced for 187 representative libraries. For periodicals already listed in the first edition locations additional to those there traced have since then come to light in these libraries, and are now included. The length of 'run' of volumes in the given library is noted, its date of commencement, or, if terminated, when; and whether suspended in the War, or whether the 'run' itself is imperfect. Sequels under change of title are also shown; also titles repeated in a second language; and where a title has been changed at some time from one language to another, both forms of title are quoted though the earlier alone is registered numerically. Some of these data are miniature footnotes to the great page of history itself.

To-day the busy scientific worker is snowed-under by periodical literature. There drifts upon him a mass of papers, some for his purpose requiring to be read and others not so requiring. This situation has called forth that other type of periodical, which furnishes classified précis, or 'abstracts' of papers published elsewhere. From the special abstracting periodical the worker gains relief; he gets guidance as to what is actually relevant to his own work. The abstracting periodical, however, has its difficulties. One is that a fringe of relevant papers finds publication in channels which contribute only occasionally to the field to be 'abstracted'. Of such channels some, for example, *Transactions*, *Memoirs*, *Proceedings*, etc., of academies, and like bodies dealing fundamentally with science in general, will contain papers of value. This class of channel is active to-day. Its units increase in volume. Their issues, embracing many subjects, may deal but rarely with some particular one. Hence their contribution tends to escape the specialist or reach him late because of its 'fringe' channel. This difficulty the list before us relieves by indexing the extent and the location of the 'fringe' channels the abstracting net must reach if it is to catch fully the relevant literature of the subject. The List serves also any who would themselves control a field 'abstracted', or seek actual access to papers indicated by 'abstract' but not available to hand.

The volume before us shows that for a considerable proportion of the periodicals extant no copy at all, to judge by the 187 representative libraries addressed, exists in Great Britain. Sometimes this is true of a third or more of the items in a page column. Such deficit of intake of foreign scientific literature must *in toto* amount to more than merely negligible disadvantage to the country. The foreign literature of which the supply seems to stand least in need of expansion is that of Central Europe; outside that the leanness of the intake calls out for remedy. A measure of relief might be effected were libraries in agreement one with another to devote each some margin of income to securing one or more periodicals not taken by the rest. The tale of missing serials could thus be minimised. Each contributory library would secure some items specially or uniquely its own and help in the common cause to remedy a serious defect in the national equipment. The policy could be the more effective in view of the co-operative loan-system between accredited libraries, with the National Central Library as clearing-house. A particular holding of the outlier library once recorded in the "World List", any worker could readily find whether or where the periodical otherwise inaccessible to him is available for him on accredited application.

One feature of library operation which perusal of the List stresses for avoidance is undue overlap of intake. The first edition of the "World List" indicated instances of this. The need to improve the existing intake of foreign periodicals by extending the intake in certain directions indicts unnecessary overlap of intake not only as wasteful, but also as a positive obstacle to progress. This argument applies the more in these days of financial stringency. It is reinforced further by the call to meet some among new periodicals which will come. In all this matter the lure of the long 'run' has undoubtedly been a hindrance to improvement. A *Zeitschrift* or a *Journal* may deteriorate, its price become excessive, a new competitor excel it, or be better representative, etc., and yet reluctance to break a long 'run' immobilise the library against the needful change. Some of the scruples against such freer policy vanish with publication, as in the "World List", of an easily accessible record, notifying such changes to the inquirer. Such notification usefully unfreezes library intake. Indeed, public interests which the "World List" has at heart would be forwarded could there appear, perhaps biennially, an interim supplement recording, as far as concerns the List, changes of intake by the libraries on the List.

The comprehensiveness of the catalogue before us is impressive. The volume received a grant of £1,000 from the Royal Society towards its cost. Science, pure and applied, with a vast range of technology adjunct, commingle throughout its

pages. In deciding as to whether the scope of a given periodical does or does not come under the rubric 'natural science' the List has rightly taken the wide view. Such difficulty is perhaps greatest with sociological items. A debatable omission seems *Philosophy*, the journal of the British Institute of Philosophy. But indeed the List is extraordinarily complete. The whole work earns our grateful acknowledgment and admiration.

C. S. S.

Algebraic Surfaces

Principles of Geometry. By Prof. H. F. Baker. Vol. 6: *Introduction to the Theory of Algebraic Surfaces and Higher Loci.* Pp. ix+308. (Cambridge: At the University Press, 1933.) 17*s.* 6*d.* net.

THE book under review is the sixth volume of the "Principles of Geometry" by Prof. H. F. Baker, of St. John's College, Cambridge. As expository treatises of algebraic geometry, these six volumes occupy an unrivalled position within their own field, viewed from the aspect of international scholarship. They begin from the elements of the subject and carry the development forward with a majestic sweep that is without parallel in any other language. A great deal of the subject-matter is abstract, but the author never fails to adduce concrete examples and theorems, so that the faith of the weak is strengthened while that of the strong is never allowed to reach into regions of nebulousness. Prof. Baker is indeed to be congratulated on collecting and correlating this vast field of geometric theory, so that every well-trained mathematician, whether a professional geometer or not, can share in the triumphs and apprehend the conquests of those who make geometrical research their main object in life.

The subject-matter of the first five volumes was indicated when reviewing vol. 5 (NATURE, Feb. 3, 1934, p. 155). Vol. 6 consists of seven chapters. Chap. i deals with "Algebraic Correspondence"; chap. ii with "Schubert's Calculus, Multiple Correspondence"; chap. iii with "Transformation and Involutions for the most part in a Plane"; chap. iv with "Preliminary Properties of Surfaces in Three and Four Dimensions"; chap. v with an "Introduction to the Theory of the Invariants of Birational Transformation of a Surface, particularly in Space of Three Dimensions"; chap. vi with "Surfaces and Primals in Four Dimensions, formulæ for Intersections"; chap. vii with "Illustrative Examples and Particular Theorems".

It will be immediately evident that the whole of such a vast canvas cannot be passed under review and that only specimen sections can be surveyed. Chap. iv on the preliminary properties of surfaces in three and four dimensions will be found particularly attractive by elementary students of geometry and by more general readers. The introductory paragraph may be quoted *in extenso*:

"We consider an algebraic surface of order n, in ordinary space, in which the co-ordinates are x, y, z, t; and certain properties of the tangent cone drawn to this surface from an arbitrary point. We suppose, unless the contrary be stated, that the multiple points of the surface consist at most of the points of a double curve, whereon are triple points of the surface, through which pass three sheets of the surface; so that such points are also triple points of the double curve, with tangents not generally lying in a plane. Reasons will be given later for the conclusion that any surface can be birationally transformed to a surface of this character, so that the supposition involves no essential limitation of generality in the surfaces dealt with. At the same time, it is often convenient to suppose that, beside the double curve, the surface considered has isolated multiple points; and this possibility will also be taken into account in some of the results given."

Such problems are then discussed as the number of lines that pass through a given point in space and intersect a given surface in three coincident points. The ordinary tangent plane to a surface intersects the surface in a curve having a node at the point of contact. How many tangent planes pass through a given point in space and have the nodal tangents at the point of contact coincident? Many surfaces have double curves, that is, curves at every point of which the surface is singular and has a plane-pair instead of the usual nodal cone. When the two planes of such a plane-pair become coincident, the point is called a "pinch-point" on the double curve. The properties of 'pinch-points' are studied. If $f(x_0, x_1, x_2, x_3\ x_4)=0$ and $\varphi(x_0, x_1, x_2, x_3, x_4)=0$ be two hypersurfaces in space of four dimensions, and if x_4 be eliminated between these two equations, we shall get a surface in space of three dimensions, namely, the projection of the surface of intersection of f and φ from four dimensions into three. Just as the curve of intersection of two surfaces in three dimensions projects in general into a two-dimensional curve with a finite number of double-points, so the above surface in three dimensions, which is the projection of $f=\varphi=0$, will in general have a double-curve. The generalisation of a particular phenomenon to another more extended is a particular feature of the book, and the author never fails to focus the reader's attention on such

generalisations. The algebraic analysis in this chapter is comparatively simple throughout, while the concepts dealt with and the previous knowledge of geometry required are not such as to render the chapter prohibitive to all but experts.

Chap. v, on the invariants of surfaces, is one of the most important in the book. The treatment begins by recapitulating that in the case of a plane curve, a line through an arbitrary point O meets the curve in m points, in w cases of which two consecutive points coincide. The genus of the curve is then $\frac{1}{2}w-m+1$. This definition is then extended to the case of the points of intersection of the given curve with a pencil of curves. Finally, the question is raised, whether such a process cannot be extended to obtain similar properties for surfaces. The invariants I and w are studied. In this chapter also, a large number of concrete surfaces are studied and their characteristic numbers and invariants are given by way of illustration.

The author's treatment throughout is almost entirely algebraic, and at least one interesting question arises in dealing with geometry in space as with geometry in the plane. Should the teaching of algebraic geometry be almost entirely divorced from the teaching of Abelian integrals ? Riemann-Roch's theorem always seems to many a very artificial and difficult theorem from the point of view of algebraic geometry, but it becomes a comparatively easy and natural theorem when the elementary results of Abelian integrals are known. The results of the researches on "Théorie des Fonctions Algébriques de deux variables indépendantes" set forth by Picard and Simart in their treatises with this title are mentioned by Baker, but it is not his intention and it is beyond his professed scope to develop the subject matter of his geometry at length on these lines. The invariants relating to a surface present themselves very sharply defined when these generalised Abelian integrals are studied. It seems relevant at all events to raise the question of a more complete *rapprochement* in general teaching and exposition between geometry and the results of Abelian theory.

"Some books are to be tasted, others to be swallowed, and some few to be chewed and digested," says Bacon's Essays. Every mathematician will have to decide for himself under what category he falls with reference to this book, but it is one of the merits of the book that it forces the reader to a decision. It is a great book and much of it is undeniably difficult. But it is full of information, of vistas, and of glimpses into unpenetrated tracts. It challenges and it grips, and once again Prof. Baker has laid us under a deep debt of obligation.

W. P. M.

Ornithology of the Philippines

The Birds of the Philippine Islands: with Notes on the Mammal Fauna. By the Hon. Masauji Hachisuka. Part 2. Pp. 169–439 + plates 25–39. (London: H. F. and G. Witherby, 1932.) n.p.

THE present, or second part, of the work of the Hon. Masauji Hachisuka on the birds of the Philippines contains the following orders—Columbiformes, Ralliformes, Pygopodiformes, Tubinariformes, Telmatoformes, Archeiformes, Anseriformes and Pelicaniformes. Mr. Hachisuka's Telmatoformes is merely another name for Dr. P. R. Lowe's Telmatomorphæ, and the author also adopts the same sub-orders as created by Dr. Lowe for that order. As this embodies the very latest ideas on the subject of the classification of this most difficult group, the author has been wise in accepting for the present the order practically as defined by Dr. Lowe.

At the same time, as Dr. Lowe himself suggests, it is possible that much more remains to be learnt about the intergradation or distinctness of the various groups in the order before systematists can hope for a really final solution of all their difficulties. Two families of birds in especial present many difficulties which have not yet been by any means finally disposed of. In his important article in the *Ibis*, Dr. Lowe pointed out that the curious little family of *Burhinidæ*, or Stone Plovers, showed certain structural characteristics which linked them with the cranes or *Gruidæ*. This, however, even though not *proved*, will probably be generally accepted, but the next family, the *Jacanidæ*, containing those remarkable birds the water pheasants, cannot be finally accepted as belonging to the order without any doubt. Stuart Baker in his recent work on the fauna of India raised this family to the rank of a sub-order by itself, there being undoubtedly many structural characteristics which would seem to bear witness to the very early breaking off of this group from their ancestors, who may or may not have been cranes.

On referring to the author's *Limicolæ*, we find that here again he has relegated Stuart Baker's suggested sub-order *Rostratulæ*, or Painted Snipes, to the rank of a family, possibly quite correctly; but possibly, on the other hand, further examination may prove this to be wrong. As regards the other orders dealt with by the author in this part, there is not very much to be said. The ducks and geese he divides into three sub-families, Plectroptorinæ, Anatinæ and Marilinæ. As regards this last the name should surely be Nyrocinæ. There are three genera of diving ducks in the area treated, namely, *Marila*, *Netta* and *Nyroca*. *Marila* was created in 1852–53 (Vögel, "Reich. Nat. Syst.", p. 8), *Netta* in 1829 ("Kaup. Skizz.

Entwick. Nat. Syst.", p. 112), and *Nyroca* in 1822 (Fleming, "Philos. Zool.", vol. 2, p. 260). This last is therefore the earliest generic name of the diving ducks and we believe that it is now generally accepted that the oldest genus should form the basis for the name of the sub-family.

We notice also that in the *Limicolæ* the author still uses the name *Xenus* for the Terek Sandpiper. This name was resuscitated by Stuart Baker for this bird but the latter himself corrected this in vol. 8 of his "Birds of India", showing that *Xenus* of Kaup 1829 was invalidated by *Xenos* of Rossi 1794, so that we can still use the long accepted name *Terekia*. Possibly the author does not agree with the generally accepted rule that terminals of this nature invalidate the later names. Thus we notice that in dealing with the pigeons he still uses the name *Sphenurus* of Swainson, 1837, though most systematists consider that this cannot be used as Lichtenstein used the name *Sphenura* in 1920 for a very different genus. *Sphenocercus* of Gray ("List Gen. Birds", p. 57, 1840) must be used.

In some cases we also notice the author retains spelling now generally discarded. Thus *Gorsachius* (Bonaparte, "Consp. Av.", 2, p. 138) was certainly published after April 1855 and therefore *Gorsakius* (Gray, "Gen. and Subgen. Birds", p. 114), which was published on April 9, 1855, should be used.

The format, of course, continues the same as that employed by the author in Part I. He thus first gives the scientific and trivial English names, Japanese names, then references and distribution; next, a very full description and some brief notes, the latter including habits and nidification. These notes, we must admit, we should like to have seen a little fuller, whilst in some cases the descriptions might perhaps have been somewhat abridged. After dealing with genus or species, the author then gives an excellent summary of allied families and their ranges, an addition to the work which must have entailed an immense amount of research and trouble but which is of great value. On the whole, the author freely accepts genera though he reduces a good many names to synonyms and certainly cannot be accused of being a wholesale splitter. He has, however, frequently been ruthless in refusing to accept sub-species as definable, especially when he does not consider their stability proved for any given area. On the other hand, in a few cases he accepts a greater number of races than we ourselves would recognise, as for example those of the common moorhen.

The keys given to families and species are good, but we suggest that in some cases they refer to points which are scarcely diagnostic, as, for example, the fact that the males of *Rostratula* perform the duties of incubation. Such biological facts, though of the greatest interest and possibly giving a lead to diagnosis, cannot be said in such instances to constitute in themselves diagnoses, by which it would be possible to differentiate either species or groups of species. We are glad to see, on the other hand, that considerable stress is placed on colour, colour-pattern and the plumage of the young, characters to which Lowe has constantly referred in his work on the *Limicolæ* and which are only too often neglected by modern systematists.

A work on a scale so great as the present one will naturally contain a certain number of points on which all systematists will not agree. These, however, cannot be termed wrong, being merely matters of opinion. The reviewer would certainly not agree to the Rednecked Phalarope and the Grey Phalarope being assigned to the same genus, but would place the former in a separate genus, *Lobipes*, easily distinguished by its slender cylindrical bill. Again, the author gives full specific rank to *Sterna longipennis*, yet the reviewer holds this to be nothing but a sub-species of our common tern, *Sterna hirundo*, being as the author himself says, indistinguishable from it except by its black bill, while it does not overlap in geographical distribution with any other race of that bird.

Considering the work as a whole, we can only congratulate the author on its excellence and completeness. Every work of this nature merely forms a basis for future work. Macgregor's "Hand-list of the Birds of the Philippines" appeared in 1926 and since then merely additional notes by the same author and a few odd notes by other ornithologists have appeared from time to time in different publications. The present work brings all our information on this group of islands completely up to date and gives in a compact form not only the results of the author's own work but also the collated information from various sources, rendering it comparatively easy for systematists, biologists and field naturalists to continue on their own especial lines of work.

The make-up of the book is all that can be desired. Misprints and slips are extraordinarily few, but there is one of the latter to which we would direct attention on p. 309, where on lines 9 and 11 the author refers to the difference between the "Fantail Snipe" and the common snipe, presumably meaning the Pintail Snipe and the common snipe. The book is illustrated with charming colour plates by Japanese artists and still more charming black-and-white plates, on each of which three or more photographs are given of various groups of birds, their surroundings or of their breeding grounds, nests and eggs. The book will form not only a welcome, but also an indispensable addition to the library of everyone working on ornithology whether on Palæarctic or Oriental forms of bird life.

Short Reviews

Principles of Animal Biology. By Prof. A. Franklin Shull, with the collaboration of Prof. George R. Larue and Alexander G. Ruthven. (McGraw-Hill Publications in the Zoölogical Sciences.) Fourth edition. Pp. xiv+400. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 21*s*. net.

PROF. SHULL's book is deservedly popular in the United States, and has passed through three editions since it first appeared in 1920. The present (fourth) edition has been thoroughly revised and contains up-to-date material upon which an interesting and instructive introductory course of zoology might very well be built. The content of the subject of zoology has undergone great changes during the last twenty years or so, and it no longer consists largely of studies of structure, a hunt for anatomical comparisons and the making of new species. It is rather the study of function and behaviour which is the present growing point of the subject. The science has in fact become very largely experimental, and in the teaching of zoology changes in the content of courses and in the method of presenting the material have been gradually appearing. In the United States these changes seem to have taken place more rapidly than in Great Britain, and Prof. Shull's book is evidently the outcome of considerable thought and teaching experience.

The book begins with a sketch of the history of biology, proceeds to consider living matter, cells and unicellular and multicellular constitution. Then follows a series of chapters on the general functions of animals, including very good general accounts of breeding habits, embryonic development and genetics, the latter with a number of problems. An account of the principles underlying classification is then given, followed by an outline grouping of the animal kingdom. The last four chapters of the book are particularly good, and it is refreshing to find ecology, geographical distribution, fossils and evolution treated in such a modern manner in a book designed for students as an introduction to the subject.

The book is illustrated with nearly 300 figures, and there is a useful explanatory glossary of technical words. A further good feature is the series of references for further reading given at the end of every chapter. These are nearly all references to modern standard books, and give the particular portions of chapters which are related to the part of the subject discussed.

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der deutschen chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 8: *Jod.* Lief. 2. Pp. xviii+xxiii+245–660. (Berlin: Verlag Chemie, G.m.b.H., 1933.) 68.50 gold marks.

WITH the appearance of this number, the volume dealing with the four halogens is complete. The present issue deals at considerable length with compounds of iodine with hydrogen, oxygen, nitrogen and other halogens. Very full details are given of the well-known and often quoted equilibrium between hydrogen, iodine and hydrogen iodide, and the effects of ultra-violet radiation, the electric spark, catalysts and α-rays upon the system are all reviewed. Then follow various methods of preparing the gas and the acid solution. On the large scale, both products are generally prepared by the method commonly used in laboratories, namely, the interaction of iodine, phosphorus and water. A fairly recent American technical process is quoted in which hydrogen is allowed to react upon iodine in the presence of suitable solvents, such as water, acetic acid, carbon tetrachloride, toluene or stannic chloride under a pressure of nearly 500 atmospheres.

The physical properties of hydrogen iodide are fully detailed. The disparity between the diameters of the hydrogen ion and the iodide ion is so pronounced that the dipolar character of the compound is very seriously weakened and the molecules become almost, if not quite, homo-polar. Optical properties are recorded fully with curves showing extinction coefficients of absorption.

Amongst chemical properties we find prominence given to the oxidation of the iodide ion by various reagents and to the metallic iodides. The question of pure solid polyiodides seems to have given rise to considerable differences of opinion, but there is evidence of the existence, at any rate, of hydrates and solvates of KI_3, KI_7 and of KI_9. The various oxidation products of the halogens react freely with one another, often in such a fashion that an intermediate product stabilises itself by partial oxidation and partial reduction. The possibilities are very numerous and a useful summary is given of all the stoichiometric and reaction velocity equations involved in these reactions, together with references to pages in the text.

Flora of Syria, Palestine and Sinai: a Handbook of the Flowering Plants and Ferns, Native and Naturalized, from the Taurus to Ras Muhammad and from the Mediterranean Sea to the Syrian Desert. By Dr. George E. Post. Second edition, extensively revised and enlarged by John Edward Dinsmore. (American University of Beirut: Publications of the Faculty of Arts and Sciences, Natural Science Series, No. 1.) Vol. 2. Pp. xviii+928+5 plates. (Beirut: American Press; London: Oxford University Press, 1933.) 42*s*. net.

THIS volume completes the new (second) edition of Post's well-known flora of Syria, Palestine and Sinai. It has been revised and enlarged by J. E. Dinsmore of the American Colony in Jerusalem. The sequence of families for the Angiosperms is approximately that of the Bentham and Hooker system and the second volume includes the Gamopetalæ from the Compositæ to the Plantaginaceæ, the Incompletæ, the Monocotyledons, and the Vascular Cryptogams.

It also contains additions and corrections to both volumes, general indexes to Arabic, Hebrew and Latin names, and outline black and white maps, indicating the position of many of the localities quoted.

It is unfortunate that the keys are not uniformly constructed and that they are frequently incomplete. The first purpose of a flora such as this should be to enable the student to identify plants native to the country with the greatest possible ease and accuracy. Concise dichotomous keys leading to single species, not merely to groups of often 'critical' species, are a great help to identification, and their construction tests the validity of the author's taxonomy. Another criticism which can be brought against the book under review is the poor drawing and reproduction of many of the figures.

On the other hand, the new edition of the flora will be of great use to botanists studying the plant-life of the Nearer East, since it includes so many recent discoveries of new species and varieties and extended distributions. W. B. T.

Uncle Joe's Nonsense: for Young and Old Children. A Medley of Fun and Philosophy reported by J. W. Mellor. (Published for the Ceramic Society.) Pp. xii+231. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 12*s*. 6*d*. net.

THERE is more than a touch of the Carrollesque about this delightful foil to Dr. Mellor's chemical publications. Here we encounter the author of the monumental "Comprehensive Treatise on Inorganic and Theoretical Chemistry" (in thirteen volumes and still running) in his hours of ease—which appear to be more numerous than many students of chemistry have suspected! The book is one of airy persiflage, full of the pert and nimble spirit of mirth, dedicated appropriately to nieces and nephews in New Zealand, and forming a delicious *pot pourri* of ornithological studies, journeyings by land and water, lessons in dancing, and other 'trifles'.

"Why is the ship called *Laconia*?" The unsuspecting questioner caught a tartar, for in his reply the author of the "Comprehensive Treatise" traced the word conscientiously "through *lacus*, a lake, to a ship sailing on water, not in air. I supported my derivation by quoting analogous cases: *gramophone*, from the Greek *gramo*, I speak, *phono*, through a tin tube; *virgin*, from the Latin, *vir*, a man, and *gin*, a trap—a man-trap; and *husband*, from the Old English *hussy*, a woman, and *bond*, a tie—tied to a woman . . . I also added that the ship was called *Laconia* because *Laconia* was its name. I had in mind the boy who asked one of the keepers at the Zoo why the lions in his charge were called 'lions', and who received the illuminating answer, 'Because lions is what they are'."

The book abounds in clever verses and ingenious drawings. It will convince all who have the good fortune to read it of the fallacy of the idea that the man of science is necessarily devoid of humour and humanism and incapable of expressing himself in the common tongue, and for this reason in particular we welcome its publication. J. R.

A Text Book of Applied Hydraulics. By Prof. Herbert Addison. Pp. xii+409+24 plates. (London: Chapman and Hall, Ltd., 1934.) 21*s*. net.

IN general, this work covers the usual field of modern textbooks on hydraulics, commencing in part 1 with a brief account of the fundamental principles of hydro-mechanics and proceeding in part 2 to deal with the practical applications of the subject to pipes and pipe systems, open channel control, hydraulic turbines and pumping machinery. The book has been designed for three classes of reader: the general student; the electrical practitioner, within whose province it falls to be familiar with the performance of pumps and turbines rather than with their mechanical details; and the specialist in water supply, irrigation and the construction of pumps and turbines. For the first of these classes, part 1 has been provided together with a number of worked out examples. These examples with their solutions occupy a considerable section of the book (64 pages) and are a valuable feature. The second class will find their needs specially catered for in part 2, while the third class may be expected to gather from the principles enunciated throughout the book a reliable basis for the study of more detailed treatises.

The rapid expansion of the use of hydro-electric power has led to important developments in turbine design, and units of very considerable horse-power are now in operation. Two chapters are devoted to a consideration of the construction and performance of hydraulic turbines. These give a serviceable comparison of the leading types, and there are useful diagrams of turbine performance and characteristics. The volume concludes with a chapter on hydraulic measurements. B. C.

Liquid Dielectrics. By Dr. Andreas Gemant. English translation by Vladimir Karapetoff. (National Research Council Committee on Electrical Insulation, Monograph No. 2.) Pp. ix+185. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 18*s*. 6*d*. net.

DR. GEMANT's monograph will be of value to all research physicists and engineers. He discusses first the resistivity, and dielectric constants of liquids, pointing out that as a rule the higher the resistivity the smaller the dielectric constant. From the practical point of view, it seems a pity that nearly all liquid dielectrics are organic substances, as inorganic compounds are generally much the more stable. The thermal, mechanical and optical properties of liquids are discussed and also their behaviour in an intense electric field.

The liquid dielectric most frequently used in electrical engineering is a mineral oil, and in high voltage cables it may be subjected to the most intense electric stress for many years. The motions of the oil in the cable due to variations in its temperature caused by change in the load sometimes cause empty spaces in the cable and so considerably weaken its resistance to electric stress. To prevent this, the use of a lighter oil in place of the heavy impregnating compound is being tried.

Normal and Abnormal Colour Vision*

By PROF. H. E. ROAF

RECENTLY attention has been directed to the number of accidents caused by mechanically propelled vehicles. The use of coloured signals may lead to difficulties for drivers with defective colour vision. Until the colour vision of persons who seem to disregard the coloured lights is tested, we do not know to what extent coloured lights constitute a difficulty to motor drivers with defective colour vision. In any case the remedy is simple, as a difference in shape of the coloured lights would be sufficient to prevent mistakes. It is true that the relative positions of the lights and other data may help in the recognition of the colour, so that the problem is not so serious as in the case of railway and marine services.

The aim of this address is to discuss three aspects of the physiology of colour vision. The first aspect is the validity of the trichromatic hypothesis. There may not be many new things to be said, but a restatement of the arguments is useful as showing to what extent the hypothesis can be relied upon. The second aspect is the nature of the departures from normal colour vision of those with defective colour vision. The third aspect is a brief consideration of some theoretical views on the nature of colour-perceiving mechanisms.

PHYSIOLOGICAL MEANING OF COLOUR

Colours are visible in the spectrum, and we can recognise certain colours which seem unitary and distinct from all others, namely, red, yellow, green and blue. There are, however, other unitary sensations which must be considered, namely, white and black: these cannot be produced by stimulation with any one region of the spectrum. These two sensations are sometimes described as belonging to the colourless sensations, but psychologically one cannot separate them from a discussion on colour.

Thus we find that certain colours are related to definite regions of the spectrum, but there are other sensations which do not correspond to any single group of wave-lengths: the latter are the purples, white and black. All colours can be represented by fusion of lights from several regions of the spectrum, and the minimum number of regions is three. This physical relation is generally considered of paramount importance in the discussion of colour vision.

In 1802, Young postulated that there were three sensory mechanisms, because all colours could be reproduced by a combination of three regions of the spectrum. There has always seemed some difficulty in reconciling this view with the psychological point of view that there are six distinct kinds of visual colour sensation, namely, red, yellow, green, blue, white and black. In the discussion of this problem, some of these simple psychological effects can be shown to be built up from other sensory processes. The discussion of the sensation of yellow occupies an important place, but before we deal with the sensation of yellow it is simpler to consider the sensations of white and of black.

Sensation of white cannot be produced by any single unitary physical stimulation. It requires the simultaneous action of light from more than one region of the spectrum. This seems to me a fundamental consideration, because if a simple sensation like white can be produced only by a heterogeneous stimulation, it is possible for a simple sensation like yellow to be the result of a heterogeneous stimulation. The sensation of white can be produced by stimulation by light from the whole of the spectrum, or from three or from two selected regions. There is no fixed standard of white. A white surface is one that reflects all visible wave-lengths well and equally. In order to define a 'white' light a standard is taken of the radiation of a perfect radiator at 4,800° K. or other specified temperature. When a white sensation is produced by light from two regions of the spectrum, the separate sensations produced by these radiations are said to be complementary.

Black sensation cannot be produced by any combination of radiations. It is always the result of a *relative* deficiency of stimulation. A black surface is one that does not reflect any visible wave-length to an appreciable extent. To produce a black effect with spectral lights a brighter light must shine alongside them. Thus, a red produced by wave-length of about 6500 A. looks brown when a bright yellow produced by wave-length of about 5900 A. shines alongside of it.

The transition between white and black through grey depends upon the relative amount of illumination. There must, however, be the right mixture of wave-lengths, otherwise the grey will be tinted with the colour sensation produced by those wave-lengths which are in excess.

We are now in a position to consider the phenomenon of yellow. Yellow is a unitary

* From the presidential address before Section I (Physiology) of the British Association, delivered at Aberdeen on September 10.

sensation which can be produced by a single group of wave-lengths or by two groups, one each on the 'red' and 'green' sides of the 'yellow' region. If we are to believe that three types of sensory mechanism are sufficient to account for colour vision, one of the four colours red, yellow, green and blue must be due to a stimulation of at least two of the other ones. For several reasons, yellow has been chosen as the heterogeneous one.

To my mind there is no more difficulty in considering yellow as due to stimulation of two types of receptors than to consider white as due to stimulation of more than one type. Experimental evidence supports this view. Macdougall, Rochat, and others have shown that a 'red' stimulus to one eye and a 'green' to the other will give a sensation of yellow. This result is obtained even with lights from the spectrum. The fact has been demonstrated by Hecht, but his method is not such a satisfactory proof as that obtained by other methods, for example, a 'red' glass over one eye and a 'green' one over the other, or two definite wave-lengths of the spectrum each presented to one eye.

Central summation of this type shows that the sensation is built up in the nervous system beyond the optic chiasma, as neither eye need be stimulated by the 'yellow' of the spectrum. The red and green sensations are lost, but their disappearance cannot be due to processes in the layers of the retina. As Macdougall points out, the alternative suggested by Hering that his four-dimensional system is cerebral rather than retinal deprives his hypothesis of its special value as a theory of colour vision. Hering's theory then becomes part of a general problem of how afferent stimuli are combined to produce perceptions, which is too complex a matter to be discussed here.

As the unitary sensations yellow, white and black can be built up from stimuli associated with other sensations, it is possible to reduce the number of data for colour perception to three.

The object of the above discussion is to show that there is no real objection to the trichromatic explanation of colour vision proposed by Thomas Young.

DEFECTIVE COLOUR VISION

Abnormal colour vision may be congenital or acquired. It is not my intention to discuss certain defects in colour vision due to disease, for example, tobacco amblyopia.

Defective colour vision is a condition in which the persons affected make mistakes in matching colours. Any explanation of the nature of colour vision must be able to explain how certain colours are mistaken. The usual form of defective colour vision is congenital, and does not alter during life. This is what is generally understood when speaking of defective colour vision. The defect seems to consist in a decrease in the ability to distinguish 'red' from 'green', and the subjects distinguish fewer colours than the normal (euchromat); hence they may be spoken of as hypochromats. It is very difficult to compare the sensations of such cases with those of a normal person, but they are frequently described as having blue-yellow vision. Another way of expressing the fact is to say that in the spectrum they distinguish blue from not blue, whereas the normal person subdivides the not blue into red and green. As 'yellow' occupies the region between 'red' and 'green', the defect is most noticeable in the 'yellow' region of the spectrum, especially in the milder degrees of the defect.

Part of the evidence for these statements is that analysis of the mistakes made by hypochromats are all explained by a failure to distinguish red from green. Further evidence is furnished by observations on colour discrimination.

By measuring the difference in wave-length necessary to cause a difference in colour, it is found that normal people have two main maxima of discrimination where a difference in colour is recognised for a minimal change in wave-length. These maxima of discrimination probably indicate where there is a most rapid change in the ratio of stimulation of two different types of receptor organs. The hypochromat shows only one maximum of discrimination, thus suggesting that he has only two types of receptor organs.

In extreme degrees of this defect, the whole range of colours can be reproduced for these people by fusion of light from two regions of the spectrum.

The normal maxima are in the 'yellow' and 'blue-green' of the spectrum, whilst the hypochromat has only one maximum, that in the 'blue-green'. It appears as if the distinction on each side of the yellow had been diminished or lost: hence the failure to distinguish 'red' from 'green', and the whole not blue portion of the spectrum appears more or less of one colour. The bearing of this on any theory of vision is that we must be able to explain how the distinction between red and green can disappear, yet without marked decrease in the visibility of any portion of the spectrum. The threshold for light is not necessarily altered, and it is possible for hypochromats to see clearly through a filter which allows only the red end of the spectrum to pass through. In fact, a hypochromat who cannot see red geraniums amongst the green leaves can distinguish the flowers as light objects against a dark background when looking through a red glass filter.

Theories of Colour Vision

In order to explain the phenomena of colour vision, it seems that it is necessary to have three groups of nerve fibres passing to the brain—one group giving rise to sensation A, a second to sensation B, and a third to sensation C. We must discover what wave-lengths stimulate A, B and C respectively, what sensations are produced by stimulation of one of these alone, and what is the effect of stimulating more than one of these, either to the same degree for each or to different ratios of response. Stimulation of the receptors may correspond to definite wave-length groups, but there may be a certain amount of rearrangement in the retinal synapses. It does not seem probable that the number of types of receptors or groups of nerve fibres can be reduced below three, if frequency of the impulses is to be related to intensity of stimulation, and if only one kind of impulse can pass up each fibre. It is like the solution of simultaneous equations: the number of equations must be at least equal to the number of unknowns to be found. That seems to be the essence of the trichromatic hypothesis as suggested by Young.

Helmholtz introduced the view that the differentiation is due to the presence of three photo-active substances which are acted on by the long, medium and short wave-lengths of the visible spectrum respectively. The range of radiation which affects these three substances overlaps so that, for example, some rays affect all three of these substances. Up to the present, there is no definite evidence for the presence of three photo-active substances; only one photo-active substance, rhodopsin or visual purple, has been found. Apart from this fact, the view of three photochemical substances such as postulated by Helmholtz does not agree with the experimental evidence. For example, in order to explain hypochromatism, it is not assumed that one photo-active substance is absent, but that the range of activity has shifted so that the one substance is activated by the range which was formerly active on the two separate substances. It does not seem likely that such a chemical transformation would occur.

Another suggestion is that put forward by Schultz (1866), namely, that there is one photochemical substance but different coloured filters to distinguish the various regions of the visible spectrum. Such filters have been found in amphibians, reptiles, birds and marsupials, but have not been found in other mammals. The coloured filters in the birds' retinæ would explain the type of colour vision found in man. For example, by reducing the intensity of red pigment in the red filters the various degrees of hypochromatic vision would be produced, but in a single human eye examined by me no such filters could be seen.

My own work leads me to suppose that the types of receptors which are stimulated by visible radiation are as follow:—

The first type of receptor is one which is stimulated by all parts of the visible spectrum and gives rise to a sensation of violet when stimulated strongly by itself. It is with some hesitation that one states that violet is due to stimulation of a single receptor, as psychologically it suggests a mixture of blue with a little red. If violet is the sensation corresponding to stimulation of one type of receptor, we must regard the unitary sensation of blue as due to stimulation of the receptors for green and violet. It may be that blue is the sensation due to stimulation of the single receptor, and that violet is the result of stimulation of the receptors which give rise to blue and to red sensations. This matter must be left in abeyance, but the use of the term 'violet receptor' is to be understood to mean either the receptor for violet or blue. Owing to the fact that fatigue to 'red' causes violet to appear more blue, Wright believes that the single receptor gives rise to a sensation of blue.

The evidence for the first part of the above statement is the same as that which caused Hering to speak of a white-black substance and von Kries to describe a bluish-white sensation as due to stimulation of the receptors for achromatic scotopic vision: these usually being regarded as the rods.

The evidence for the second part of the above statement is first of all that a narrow beam of any wave-length when shining slightly eccentrically gives rise to a violet sensation. This has been called secondary excitation, implying that the sensation is due to stimulation of receptors by nerve impulses passing along fibres of the optic nerve. It is unlikely that such stimulation would occur, and if so, why should the sensation produced be violet? On the whole, it seems simpler to interpret it as stimulation of rods by any wave-length. Furthermore, diseases involving the rods lead to night blindness or raising the threshold of achromatic scotopic vision. If this threshold is sufficiently raised, then there is loss of vision for violet, so that the distinction between green and blue is lost. This defect is a true violet blindness, because it is accompanied by a raised threshold for the short wave-length end of the spectrum. Finally, adaptation to light conditions is accompanied by a special raising of the threshold to the short wave-length end of the spectrum. Therefore, although the point is not proved, there is much evidence in favour of violet vision being a function of the rods.

The second type of receptor is one which is concerned with the not blue aspect of vision of the hypochromat. These may be cones, of which there need be only one variety for the hypochromat.

The third type of receptor would be functional in normal vision, and it seems as if this second variety of cone were one that distinguishes red from not red, and according to the activity of this variety the stages between normal vision and complete red-green confusion can be bridged.

Therefore, normal vision may be due to a receptor which gives rise to a red sensation, one which gives rise to a blue sensation and one which gives rise to a not blue, not red sensation which, of course, corresponds to green sensation. The actual wave-lengths of radiation that stimulate the several receptors are not known. The real difference between various hypotheses is the extent and region of the spectrum which stimulates the end-organs.

In the Young-Helmholtz hypothesis the type of receptor responsible for the sensation of red is stimulated by almost the whole of the spectrum, but most strongly by the long wave-length end. The receptors for green are stimulated by almost the whole spectrum, but most strongly by the mid-region; and those for blue are stimulated by a large extent of the spectrum, but most strongly by the short wave-length end.

'Red' light of longer wave-length than 6200 A. is supposed to stimulate the red receptor only, whilst shorter wave-lengths will stimulate the red receptor to decreasing degrees, but the other receptors to increasing extent, hence the change of colour with wave-length.

Sources of Cheap Electric Power*

By PROF. FRANCIS G. BAILY

THE general idea of the scheme of production of electric energy proposed takes as its basis the complete linking up of all parts of Great Britain by the Grid, and the subsidiary lines fed from it or from the stations directly. All stations are connected to the Grid, and as well as supplying their local consumers, put the additional power into the Grid as required. This is the well-known main function of the Grid. It is here submitted that this leads to a different scheme of generation from that now followed, and that sources of cheap power are rendered available that previously could not be utilised economically.

The questions to be considered are: (1) The proportion of consumers who are within economic distance of a pit-head station. (2) The quantity of very cheap coal that is available. (3) The relative advantages of widely spaced large stations and more numerous small stations. (4) The opportunity offered by the Grid to bring into economical use pit-head stations at small isolated mines, power from factories using industrial steam, power from coke-oven and blast-furnace gas and hydro-electric stations. (5) The cost of transmission of electric power as compared with the carriage of the equivalent coal by rail or ship. (6) The effect of a substantial reduction in the cost of generation on the cost of distribution, and the selling price of electric energy.

The first question to be considered is whether pit-head production will so much limit the position of the sources of supply as to involve a great distance of transmission to a large part of the population.

If a distance of forty miles be regarded as still in the neighbourhood of the coalfields, a map of the coalfields shows that most of Great Britain is within this distance. A line across Scotland from Montrose to Arrochar on Loch Long is the northern boundary, and a line from Hull to Bournemouth, and up to Taunton in Somerset, marks the southern and eastern limits. A small part of Wales is also outside. Two-thirds of the population live in the area, and if London be omitted as a special case, only one-fifth of the rest are outside. There is also a probable coalfield in Lincolnshire, which if it materialises will bring in a good part of this fifth.

To a large extent, the population has gathered round the coal pits, and there are practically no large towns, except seaports, that do not lie within easy reach. A scheme depending on nearness to coal pits will have a large field for its operations, and it will in no way act prejudicially on parts which it may not be able to benefit.

It is proposed to use the lowest grade and waste coal, and the proportion required may be up to 10 per cent of the total coal raised. If the outputs of the different areas be examined, it is found that this proportion will in all cases be adequate for the population of the area. In some areas—Durham, South Wales and part of Yorkshire—where there is much less waste coal, the quantity of coal raised is so large that not more than 2 per cent will be required, which is easily provided from waste.

WASTE COAL

The term 'waste coal' will here be used to include all coal in the seam that is not at present sold, but

* From the presidential address before Section G (Engineering) of the British Association, delivered at Aberdeen on September 6.

is, or can be, brought to the surface; and coal of poor quality that will be profitably used in the pit-head station, instead of being extensively cleaned for sale.

Of the dirty coal that is at present raised and remains as the residue of cleaning operations, some is dumped on to waste land and some into the sea, but the greater part is burnt in the furnaces of the mine power-station. The consumption is wasteful in the extreme, for burning is the cheapest way of getting rid of the otherwise useless material. About 6 per cent of the coal raised is used to produce steam for power to work the mines, whereas in a colliery where the coal is scrupulously saved and there is little waste, it is found that the fuel required is only 1·25 per cent of the coal raised, and the quality of it is exceedingly low. Hence some 5 per cent is immediately available for other purposes if it is used economically, to which can be added what is actually thrown away. The use of coal cutters and dry-cleaning processes, which are cheap to operate but increase the proportion of waste, will be more used if this is saleable.

Summing up all these actual and prospective sources of low-grade coal, it may be estimated that if an overall price of 5*s.* per ton at the cleaning floors were offered, in most districts a quantity equal to 10 per cent of the coal raised would be readily obtained, with a smaller proportion in the rest, and that this would yield some 18,000,000 tons per annum, with a calorific value averaging 10,000 B.TH.U. per lb. This is 50 per cent more than is used to produce the present output of all the generating stations.

The general scheme should permit of using the waste coal from as many pits as possible, including even small isolated mines, for they assist in supplying the Grid at points otherwise unprovided for, and reduce the distance of transmission. What the lower limit of economical pit station will be need not be elaborately discussed, for the isolated pits provide only a small part of the total coal, and their exclusion does not materially affect the available supply.

The scheme will evidently provide an important amount of cheap fuel, and will permit of power stations of a size that ensures a low figure for cost of plant and running costs, so that the low price of the fuel is not offset by any increase in cost in other directions. It is true that the stations will not be placed in the towns, and to that extent distribution costs are increased; but, on the other hand, land is cheaper, and it is being found that a station consuming many hundred tons of coal a day will compel the use of expensive remedies against sulphur and dust, so the advantages of an urban site will be sensibly diminished. Moreover, most of the large towns are not far from coal mines, and the cost of transmission will be very small.

An argument that has frequently been brought against the pit-head station is that there is little likelihood of a sufficiency of cooling water for the condensation of exhaust steam, in order to produce the high vacuum that the turbine can make use of. But the gain in efficiency due to the high vacuum is often exaggerated by failure to apply comparable conditions and to take recent improvements into account. It may be claimed that the absence of cooling water can be definitely disregarded as a disability in the use of pit-head stations.

INDUSTRIAL STEAM

Another source of cheap power may be found in the proper utilisation of industrial steam. Many industries need low-pressure steam in their processes, and use boilers working at a pressure of 50 lb. or less. There is no difficulty in producing steam at 350 lb., superheating it and passing it through steam turbines, to exhaust at the required low pressure, and the steam so delivered is in all respects as good as that produced directly from boilers, as it does not come into contact with lubricating oil. The thermal efficiency of the turbine is 100 per cent, less the small radiation losses and bearing friction, for the rejected heat of the exhaust steam is used for the other purposes, and all steam friction loss is retained as heat in the steam. If the factory electric station is connected to the Grid, even a small one may put in all its spare output, no matter how irregular that may be, provided that consumers are not too far away, and that it can supply the energy at a price which will benefit all parties.

How much power can be obtained from this source it would be laborious to ascertain. Each factory would require separate consideration, and the cost of altering existing boiler plants would be important. But the change can be introduced gradually, new factories or renewal of plant affording opportunities, until all suitable factories are absorbed into the scheme. By that time the increased demand will easily take up all the power without disturbing the other sources.

The items in the cost of a unit have of recent years been codified and separated into parts dependent on the load factor and those that are independent, together with the influence of the size of the station. The costs for a normal station of 100,000 kw. and for a pit-head station of the same size have been calculated, assuming certain conditions.

At all load factors, the reduction in cost at the pit-head station is about one-twentieth of a penny per unit. While this reduction does not look impressive when compared to the usual charges for lighting, it makes a substantial difference to the cost of the unit for domestic heating, which

is now down to 0·5*d*. in some places; and it will be shown that any lowering of cost of production is followed by a decrease in cost of distribution, so that there will be a beneficial improvement on the first economy.

COST OF TRANSMISSION

The position of generating stations brings in the cost of transmission. In the coal areas, the numerous sources of supply will on the whole reduce transmission costs, but the supply of power to outside areas depends chiefly on the cost of electric transmission, as compared with other methods.

The cost of long-distance transmission of electric energy has been much reduced by increased voltage, and by reduced cost of transformers and transforming substations. It is considerably influenced by load factor, for capital charges and wages are constant, while line losses are much reduced on low load factors. For any distance of importance, the Grid at 132,000 volts will be the usual means, and the cost of transmission, when worked out for a distance of 100 miles, is only one third of the cost of carriage by rail of the corresponding quantity of coal. For shorter distances, the proportion varies somewhat, but it is always small. Carriage by sea, if the distance is considerable and both coal pits and generating stations are near the coast, is much cheaper, and coast towns distant from the coal areas will not be affected.

In the foregoing calculations of costs, the item of local rates has been omitted, for rates vary in different districts, and a general figure is not possible. The present charge for rates on electric supply stations is very high, and they have not come under the recent reduction of rates on machinery. Roughly, the item of rates on the generating plant alone amounts to about 0·06*d*. per unit, considerably more than wages and salaries, and more than half the cost of coal, and the rates on the cables bring the charge up to 0·1*d*. It is a tax or contribution towards local expenditure, which has grown to dimensions far greater than the early years of its operation seemed to indicate. Without demanding the complete abolition of rates on these public industries, some substantial reduction may be claimed, such as one-half, amounting to 0·05*d*. per unit. If to this is added the equal sum which the cheap fuel of the pit-head station can achieve, a total reduction of 0·1*d*. is obtained. The importance of this will now be discussed.

FUTURE CONSUMPTION

The cost for generation in large steam stations is 0·25*d*. per unit at the usual load factor of 0·4, while the selling price is at least 0·5*d*. for domestic heating, power being 0·75–1·0*d*., and lighting threepence to sixpence. Local rates account for some of this difference, but distribution and office expenses are the chief part. Both are nearly constant expenses for a given maximum demand, and are directly reduced by a high load factor. Also the cost is decreased by a greater density of load over an area. More consumers per mile of low-tension cable merely mean more feeding points and larger high-tension mains or a higher tension, and to obtain a more nearly universal demand and a larger demand per house is simply a matter of reduction of selling price, while they will themselves help greatly to reduce the cost further, if the process can once be started.

There are, as comparatively little developed directions for new demand, the fields of domestic heating of all kinds and electrification of railways. In these a successful competition with other methods depends largely on cost. Electric cooking, hot-water supply, and house-warming must be brought down to a figure not greatly exceeding that involved in the consumption of raw coal, if anything like a general adoption is to be brought about. A figure of one halfpenny begins to be persuasive, but above that the added convenience does not outweigh the cost in the view of most people, and even that figure only meets the competition of gas on equal terms, if the price of gas is eightpence per therm, and there are signs that this may be reduced. The possible demand is enormous, for the present consumption of domestic fuel is some forty million tons per annum, more than three times the whole of the coal used in electric supply for all purposes. Owing to the large losses of energy in the steam engine, with boiler losses and transmission, at the best only 20 per cent of the total heat in the coal burnt is delivered to the consumer. The domestic fireplace has a rather better efficiency, but it is not used so economically, so on the whole the amount of coal used will be much the same. The station uses a cheaper fuel, but loses on the cost of distribution. As domestic heating yields a high load factor, and offers scope for a high density factor, it will help greatly in lowering distribution costs.

The railways offer a large, though not so large, a field. This was explored by Lord Weir's committee of 1931, and the finding was favourable. The price of electric energy was taken at 0·5*d*. per unit, and at that figure the electric power came out at little less than the cost of present methods. Since then, locomotive designers have not been idle, and coal consumption has been reduced in the latest patterns, so that a substantial reduction on the halfpenny will be required. This should be quite possible, for the price that was assumed was

on the safe side and could be reduced to-day, and the further reductions indicated in this paper will bring the question to a practical proposition. The complete electrification was estimated to require a consumption of 5,400 million units, but probably a good many branch lines would not be electrified, and a total of 4,000 million may suffice. It is not a great addition to the total load, which was close on 16,000 millions last year, but it is a desirable increase, as it will have a good load factor and can be easily provided, for railways and population go together.

There are signs that a low price will bring in large consumers in the metallurgical industries. The use of electric furnaces is rapidly increasing, and below 0·5*d.* the private plant has little chance of competing, if complete reliability is to be ensured. The possible magnitude of this load it would be futile to estimate, but it will be considerable and will have an excellent load factor.

From the foregoing, it is evident that the electric supply industry can be put on the road to a substantial and even to a great increase, and that the new business will materially improve the load factor and reduce costs of distribution. The use of cheap fuel, and an alleviation of the burden of rates, will give the initial stimulus that is needed, and the great increase will automatically recoup the apparent loss to the rate fund of the local authorities.

To sum up the main theme, the Grid and the branch lines should operate not only as distributors of power to the consumer, wherever he may live, but also as collectors of power wherever it may be obtained, and like all successful middlemen, it should buy in the cheapest market and put the consumer into connexion with the nearest producer, whether small or large. The small producer, in other goods as well as electricity, may show very low costs of production, but fail to find a steady market. The Grid can offer such a market, and while it has no warehouse or other means of storage, it can harmonise the consumer and producer by varying the output of the large stations, which will work on the principle of keeping up the pressure at distribution centres, and the current will flow naturally to where it is demanded. The stations will gradually be placed where their costs are lowest, and the pit-heads and coal-cleaning floors will be their natural sites for the greater part of Great Britain. The economies thus made possible will attract consumers that are at present in doubt, and a great increase will ensue.

The question of the ownership of these large pit-head stations will require consideration. Several solutions are possible, but for all of them it is essential that there shall be co-operation between the producers of coal and the producers of electricity. The one party must be assured of a steady sale of their cheap fuel, that they may be willing to remodel their business to suit the new outlet; the other party must be assured of a steady low price, that they may not be exploited after they have given hostages by large expenditure on the new stations. It seems a suitable case for a central control, as without guarantees neither party would be wise to commit themselves, though the advantages to both seem fairly certain and considerable. A proposal of such wholesale common action would have seemed impracticable ten years ago; but we are becoming used to central boards, and the Coal Board and the Electricity Board are already in being for the purpose.

Aberdeen Meeting of the British Association

NOW that the 1934 meeting of the Association has come and gone, it is possible to give some account of matters which were of general interest to the members. That it has been an unqualified success is the opinion of the chief officials of the Association, other members, and the public generally. The proceedings of the Association commenced with the president's address in the Capitol buildings on Wednesday evening, which upwards of 2,300 attended. The building provided was an ideal setting for a memorable opening address.

The two evening discourses were held in the MacRobert Hall, a building which holds about 800 persons, and on both occasions the Hall was well filled. The speakers were Sir Frank Smith, who delivered the Hardy Memorial Lecture, and Prof. W. L. Bragg, and the audience at the close showed their evident appreciation.

The attendance at sectional meetings was almost without exception good, and, in some cases, more persons wished to hear particular papers than could be accommodated comfortably. On the whole, the programmes provided in the sections appear to have satisfied the demands both of the more strictly scientific members and of the general public. The accommodation provided for the meetings of sections was in every way convenient and satisfactory, as also the arrangements for mid-day meals and other refreshments in proximity to the sectional meeting-places.

Most sections had a very full programme of excursions, of which every advantage was taken. Particular notice should be taken of the Telford Exhibition housed in proximity to the Engineering Section, which was so well patronised that it was arranged to continue the exhibition until the end of the second week. A practical demonstration on

a steep gradient adjoining the City of the "B.A." noise-silencer was carried out under ideal conditions and was well attended. The river-gauging demonstration some miles up the River Dee proved of interest to a large number of members. An excursion of unique interest arranged by Section A in conjunction with the Deeside Field Club was the excursion to Inverey, near Braemar, for the unveiling of the monument to Johann von Lamont. The president in his official capacity attended, and the unveiling ceremony was performed by Princess Arthur of Connaught. In all, thirty-six excursions of archæological, biological, engineering and geological interest were arranged before the meeting, and some enthusiastic members have arranged for certain post-meeting excursions.

By kind permission of the owners, a number of works in Aberdeen and district was available for inspection by members of the Association. Each of the excursions to these works was fully booked and, in one case, so popular was the excursion that three additional visits had to be arranged. The different research institutes in the neighbourhood—Craibstone Experimental Farm, Macaulay Soil Research Institute, Rowett Research Institute, and the Fishery Board for Scotland's Marine Laboratory and the Research Station of the Department of Scientific and Industrial Research—were visited by the members of the sections interested in their respective activities as well as by other members of the Association. The Fishery Board for Scotland also generously placed its vessel, the *Explorer*, at the disposal of the local committee for demonstrations, and the vessel, which was berthed in Aberdeen Harbour during the week, was visited extensively. Five hundred members, in organised excursions, visited the Aberdeen Fish Market at 8 A.M. on two mornings; and, in addition, the various Corporation departments, particularly the municipal hospitals, attracted the attention of not a few visiting members.

A very full programme of general excursions had been arranged for the Saturday of the meeting, and the longer excursions proved to be very popular. The longest excursion, namely, the Highland excursion to Inverness, through the Grampians, up the valley of the Spey and homewards by the coast, was booked to its full capacity, and all who took advantage of it were loud in their praises of the provision that had been made for their entertainment at Clava Cairns, Culloden and at Inverness. The Deeside excursion was also well attended and proved interesting to the members of the Association who had selected that excursion. Excursions of somewhat smaller dimensions went to Elgin, the Mearns and Donside. The different excursion parties were favoured with splendid weather, which added in no little measure to their enjoyment and appreciation.

Very ample arrangements were made for the entertainment of the Association by the City and the University. Particular mention should be made of the reception in the Art Gallery and adjoining buildings on the Thursday evening, the luncheon given by the Public Library to a number of the members on September 6, and the garden party in the grounds of King's College on September 11. These were highly appreciated.

On the Sunday of the meeting, an official service attended by the chief office bearers of the Association was held in the West Church of St. Nicholas, when the Principal of the University preached to a very large congregation.

During the meeting, some of the more striking buildings of Aberdeen were flood-lit. Particular mention should be made of the flood-lighting of King's College by gas, as visiting members and others were agreed that it was the most effective and beautiful of the whole range.

The students of the University contributed to the entertainment of the members by having a performance of "Town and Gown" at His Majesty's Theatre during the second half of the meeting. On the special night set aside for members of the Association, the house was packed and the audience showed every sign of appreciation of a fine cavalcade of the history of the City and University. The wind-up of the Association's social activities was a dance in the Beach Ballroom which took place on September 11, after the theatre, and was attended by upwards of seven hundred people.

Obituary

SIR THOMAS MUIR, C.M.G., F.R.S.

SIR THOMAS MUIR, who died at Rondebosch, South Africa, on March 21, 1934, was born on August 25, 1844, at Stonebyres, Lanarkshire, and educated at Wishaw public school and the University of Glasgow. Muir showed equal ability at classics and mathematics, but was persuaded by Kelvin (who influenced him profoundly) to devote himself to the latter.

After holding a small post at the University of St. Andrews and spending some time in Continental travel, Muir was appointed in 1871 to an assistant lectureship in Glasgow, and in 1874 to be chief mathematical and science master in the Glasgow High School, where for eighteen years he taught with notable success. His powers of organisation attracted the attention of Mr. Cecil Rhodes, then Premier of the Cape Colony, and eventually Muir was elected

to be superintendent general of education at the Cape. He reached South Africa in May 1892, and with the enthusiasm of a pioneer pulled together a loose educational system into a systematic whole. He served with conspicuous success until he retired in 1915, having left behind him a broad and liberal spirit in the Cape educational system.

Muir initiated three educational reforms. First he abolished the elementary examination in the schools and improved the curriculum by the addition of domestic economy, woodwork and drawing. Secondly, he encouraged the teaching of science, which at first he found to be almost non-existent. Thirdly, he made substantial improvement in the conditions for the training of teachers. He paid careful attention to the erection of properly equipped training institutions and schools. As a friend has lately remarked, "To whatever little village you go, you will find there no better building than the school."

With unstinted singleness of purpose Muir devoted his leisure, during and after official duties, to mathematics: and his writings upon determinants have already become classical. His first book, the "Treatise on the Theory of Determinants" (Macmillan), appeared in 1882, and a second in 1890. These were followed by the well-known four-volume "History of Determinants" (vol. 1, 1906; 2, 1911; 3, 1920; 4, 1923) together with a supplementary fifth volume (Blackie, 1929). The "History" has recorded with almost complete success the name, place and contents of every published book, thesis and note upon determinants from the earliest records up to date 1920. A sixth volume running to the year 1940 was actually in preparation. In the hands of most compilers such a work could be valuable perhaps but certainly dull. Muir, who had considerable literary and poetic gifts, made it positively gay! Forty-nine years separate the date of the first list of writings on determinants from the publication of vol. 5.

Altogether Muir wrote 307 mathematical papers. He rendered notable service by making accessible to all mathematicians the pioneering work in algebra of Laplace, Bezout, Cauchy, Schweins, Jacobi, Reiss, Bazin, Sylvester and Cayley. By his artistic sense of form, his use of a telling notation and of judicious commentary, Muir moulded countless isolated and overlapping propositions into a convincing whole. He showed his greatness not in intuitive discoveries but in his eminent reasonableness. He reaches through his books a wide mathematical public, and has taken an essential part in the algebraic discoveries associated more particularly with Edinburgh, where so much of his work has been published.

Muir was a fellow of the Royal Society of Edinburgh, later receiving the Keith Prize (1884, 1899) and the Gunning-Victoria Prize (1916). He was an early president of the Edinburgh Mathematical Society, and an honorary graduate of Glasgow (1882) and of the University of the Cape of Good Hope (1901), where he was Vice-Chancellor. In 1892 he became a fellow of the Royal Geographical Society, and in 1900 he was elected a fellow of the Royal Society. He was made C.M.G. in 1901 and knighted in 1915.

Muir had wonderful health. From sixty to eighty-four years of age he played tennis, and later took exercise by sawing wood. He had a gentle kindly manner, a quick smile and a keen sense of humour. He loved flowers, was a scholarly musician, and had a fine literary sense. To the end, he preserved an unclouded brain and an acute and investigating spirit. By a deed of gift, Muir has bequeathed his wonderful library of mathematical books and serials to the Public Library of South Africa.

In 1876, he married Margaret Bell, of Dumbartonshire, who predeceased him by many years. He is survived by three generations. H. W. T.

News and Views

America and Trade Prospects

DISCUSSING the effect of American recovery on trade prospects at a luncheon arranged by the Aberdeen Chamber of Commerce on September 10 during the recent meeting of the British Association, Sir Josiah Stamp stated that the influence of a larger volume of American prosperity upon British trade would be chiefly through the stimulus of rising gold prices and lower value of gold, a revival of foreign trade, payment of debt through easier imports and a readiness to organise for an international standard of value. America could take the lead in reversing every one of the chief heresies at present throttling the world's prosperity. Unfortunately, a new phase of weakness has shown itself recently in American business activity, though in Great Britain a slight but distinct improvement has taken place since June last. In America, all the elements of which confidence can take advantage are now provided, though many new features have been introduced which confidence has to surmount, and confidence is slow in coming. The complex situation in America may be classed under three heads, (1) salvage and desperate relief efforts after the disasters of 1933, (2) steady application of recognised or new remedies for recovery and (3) long run provision for a new industrial order. The first stage is now becoming less important, and therefore the measures taken under the three heads, hitherto contrary and mutually antagonistic, ought less and less to be so and more and more to emerge with the second dominant. It is impossible, however, to press on the provisions for a new order, before trade under any order at all is strong enough to stand it. Meanwhile, our own trade revival is testing the limits of domestic trade, and if a general increase in export trades does not reinforce it, further extension can only be obtained with increasing difficulty.

Hydro-Electric Power Development in Scotland

A PAPER on "Scottish Hydro-Electric Stations" by Mr. W. T. Halcrow, read on September 12 before Section G (Engineering) of the British Association at Aberdeen, provides an interesting account of the present state and future potentialities of hydro-electric power development in Scotland. Mr. Halcrow, whose paper appears in *Engineering* of September 14, commences by quoting from the final report (1921) of the Water Power Resources Committee the estimates of power available in the British Isles, which assign to Scotland 217,965 kw., to Ireland 113,000 kw., and to England and Wales 56,340 kw., making a total of 387,305 kw. of continuous output. These figures, being based on preliminary studies and imperfect information, will probably be considerably exceeded in actual realisation. A brief summary is given of the principal developments in Scotland at the present date, in which it is shown that schemes in operation or under construction amount to 169,700 kw. and proposed schemes to 155,600 kw., making a total of 325,300 kw. It is pointed out that in the Highlands there is a large number of lochs up to 1,200 ft. above sea-level, most of which can be readily adapted as storage reservoirs, and this fact, coupled with the suitability of the topographical features and the high average annual rainfall, makes this part of the country eminently suitable for the development of water-power.

THERE are three main types of water-power development in Scotland: (1) those with a fully regulated flow from the catchment area, giving a continuous output at 90–100 per cent load factor, and generally supplying power to a factory employing electro-metallurgical or other continuous process; (2) those with a fully regulated flow, but working on a much lower load factor, and used for supplying power for general purposes; and (3) those with a partially regulated flow, and having little or no storage. These three types have separate and distinct characteristics, and examples of each are cited, including in the first class the Lochaber installation with the realisation of which Mr. Halcrow and his firm have been associated. There is, finally, a brief consideration of the relative advantages of steam- and water-power stations, from which Mr. Halcrow concludes that "notwithstanding the handicap of heavy initial expenditure, it is found that the cost per unit generated by water is less than by steam in stations of similar capacity".

Daylight Meteor

ON September 14 at about a quarter to four in the afternoon, a meteor was seen by a number of observers in the south and east of England. Perhaps the most accurate report is that given by Mr. Cullen, of the staff of the Royal Observatory at Greenwich, who went out into the courtyard to read the thermometers after observing the transit of Arcturus, the afternoon being a very clear one with a bright blue sky and sunshine. Mr. Cullen's attention was attracted by a bright object rocket-like in appearance, leaving a trail and having a very bright nucleus. The object descended at an angle of about 40° to the horizon: it was seen over an arc of from 15° to 20°, and lasted two or three seconds. The meteor disappeared as if exploding into two bright objects, but no noise was heard. The approximate position of disappearance was R.A. 19 hr. 0 min., Dec. 0°. While Mr. Cullen considers this position rough, there can be no doubt whatever about the observer's longitude and his latitude is tolerably well known. The approximate sidereal time of the phenomenon was 14h. 17m. 5s. The area over which the object was seen seems to have extended to Cromer in the north, the Isle of Wight in the south, and Weston-super-Mare and Kent on the west and east respectively.

Archæological Finds from Egypt and Samaria

Two exhibitions illustrating the results of the past season's excavations at Tell el-Amarna on behalf of the Egypt Exploration Society, and at Samaria for the Palestine Exploration Fund and other bodies, are being held at the rooms of the Palestine Exploration Fund, 2 Hinde Street, Manchester Square, London, W, on September 17–October 13. Among the exhibits from Tell el-Amarna are perspective views of the Great Temple, upon the exploration of which the expedition has been engaged recently. They have been constructed on the basis of the remains of the temple as they have now been revealed, and show the position of the votive tables and other arrangements of the temple. A remarkable sculptured sandstone head, life-like in quality, is believed to be a representation of Smenkhkara, co-regent with Akenaton. From the police head-quarters of the city come a large number of antiquities, including amulets and rings of glazed glass paste, clay moulds from which jewellery was made and numerous fragments of inscribed wine-jars. From the 'record office', clay tablets inscribed in Babylonian cuneiform and a list of scribes were obtained. The exhibition includes minutely accurate copies on ivory of the Tutankhamen jewellery by Mrs. Winifred Brunton and paintings by Miss A. M. Calverley and Miss M. F. Broome of the reliefs, paintings and inscriptions of the tomb of Seti I, showing the progress of the great undertaking of the complete record of material of this tomb which is being carried out by the Society in co-operation with the Oriental Institute of Chicago and with the financial assistance of Mr. John D. Rockefeller, Jr.

THE exploration of the city of Samaria, a joint undertaking in which Palestine, the United States and Great Britain are participating, has now been in progress for three years. Among the more important discoveries have been the Temple of Herod, contemporary with Augustus, and part of a building of the 9–8th century B.C., which is believed to be Ahab's 'House of Ivory'. Among recent finds from the latter are a number of cosmetic jars, some of which still show the smear of paint, green and blue. A further addition is made to the remarkable collection of inlay ivory carvings characteristic of the site at this period, which is now of particular interest in view of

the recent discovery at Tell Duweir of an earlier manifestation of a similar school of artistic production. Among the subjects here represented are Egyptian gods, cherubim, the winged sphinx, palms and lilies. In addition to the antiquities, a large series of photographs is shown, which gives a comprehensive view of the chronological range and the extent of the excavations, as well as of the character of the objects found.

New Aeroplane for England to Melbourne Race

THE first flights of a new racing monoplane, known as the *Comet*, designed and built by Messrs. De Havilland for the England to Melbourne race, have just taken place at Hatfield. These preliminary trials were successful, and there is every reason to believe that the machine will be ready for its official airworthiness tests in what is probably a record time, the decision to produce the machine having been made only in January last. Three machines of the type have been built, all of which are entered for the race. The most outstanding feature of the design is the thin tapering wing, in which all the shear stresses are taken by the wooden skin covering. This idea is not entirely new, but its use has been developed much further in this case than hitherto. The wing, entirely of wood, consists of one main girder member made up with three spars, distance pieces giving a cellular construction, and an amalgamating skin of thickness varying to suit the stresses applied. A leading and trailing edge are attached to complete the aerofoil form. The two pilots are placed well behind the wing, with the main fuel tanks filling the body in front of them. A further smaller tank occupies the space behind them. Two special Gipsy Six (230 H.P.) engines are placed outboard, practically buried in the wings, with such parts as are necessarily protruding below, carefully cowled. The undercarriage legs are masked behind the engines so far as possible, and the lower portions are retracted to the same space during flight.

Sting of Hive-Bees

THE point raised by Dr. J. G. Myers, in NATURE of August 25, p. 290, regarding the ability of the hive-bee to withdraw its sting, is not a new one, and has elicited a letter of protest from a practical beekeeper, Mr. Z. B. H. Garrett, of Ingoldsby, Longfield, Kent. When bees are 'induced to sting' experimentally, they frequently extricate the sting as soon as the pressure or other inducement is relaxed. Naturally a bee can withdraw its sting from the soft tissues of, say, a wax-moth larva more easily than from the thumb of the experimenter. Another point which is generally overlooked is the age of the stinging bee. Up to three days or more after emergence, young bees can scarcely be persuaded to use their stings. The typical stinging age, as was first shown by Rösch, is towards the end of the period of domestic duties, and on the eve of the outdoor foraging period. It is reasonable to surmise that the sting glands reach their maximum development at this period of the bee's life, just as the lateral pharyngeal glands do at a somewhat earlier stage—possibly to atrophy, as do the latter with advancing age. The stings received by the beekeeper as one of the hazards of his calling are given with a will by the guard bees, which are physiologically ripe for the job. Such bees make for the eyelids, nose, or the back of the neck, and seldom attempt to remove their stings, though the beekeeper should make a point of doing so, without squeezing the venom sac, at the earliest opportunity. It is otherwise with those bees that crawl up the sleeves or trouser legs. These have no *malice prepense*, and do not use their stings until they find themselves trapped by the pressure of the clothing or nervous movements on the part of the beekeeper. Such bees, if undamaged and given time, can often withdraw their stings and be coaxed out towards the light.

Mechanical Weather Forecasting

"DR. CURRY's weather prophet" is an attractive aluminium instrument, light in weight, circular in shape, and thin enough to go easily into the pocket, which is being marketed in England by W. B. M. Unland, 72 Leadenhall Street, London, E.C.3. The face of the disc is adorned with a ring of coloured slips, ranging from a deep mystical blue, like the blue of the sky seen from a high mountain, through violet to a pinkish hue. In the centre of the disc is a tiny, restless compass. The tale of magic is not yet done: there are two little fairy casements. Through one, when the stage is set, can be seen a letter telling of the direction of the wind, and through the other, Dr. Curry's weather prediction in plain black print, an austerely definite pronouncement. According to an experienced motor salesman, the public estimates the value of a motor-car by the array of instruments on the dashboard. Dr. Curry, or if not Dr. Curry, then the instrument designer who has given his idea practical shape, is evidently an equally profound student of ill-informed, would-be-expert humanity. Here is an instrument of character and charm which makes the more expensive forecasting aneroid barometer look as though it should cost far less. The price is 6*s*. 9*d*., and for an extra shilling the weather wisdom of the aneroid is 'thrown in' by a simple device. If mass production could bring the price even lower it might take even the South Sea Islands by storm, not because it is a praiseworthy attempt to get automatically a useful forecast from the observed direction of the wind and the relative humidity as shown by the hue of a chemically-treated slip, but because it is impossible for any human being to see one without being impelled to find out what it is all about.

Pulpwood for Paper in the United States

A LARGE amount of American capital has been employed for building newsprint mills in Canada. Recently, attention has been directed to the great pine forests in the Southern States and their suitability for making pulp for newsprint is being investigated. In the *Scientific American* of May, 1934, an interesting account is given by Dr. Herty of what is being done in this direction. It is pointed out that

the South Atlantic and Gulf States have within their borders more than a hundred million acres of 'cut-over' lands and more than twenty-five million acres of abandoned farm lands. Despite the carelessness of owners, magnificent forests of yellow heart pine trees have sprung up. If this wood is suitable for making pulp, then the whole needs of the United States, and in addition a flourishing export trade, could be maintained from this supply. A laboratory has been built in Savannah, and investigations on a commercial scale have been made. From the colour point of view, early experiments showed that the pulp was as good as that made from spruce in the northern mills. Later on, evidence of blue stain appeared on some of the samples and experiments were made to overcome this. It was discovered that logs left with the bark on them for three weeks showed no sign of stain (or fungus growth). The wood was therefore pulped and ground within three weeks after it had been cut. The quality of the printed paper made from it gave every satisfaction. It had a marked velvety feel, required little ink for printing and was more pliable than the average newsprint. While this work is being carried on in the laboratory, reforestation with young pine trees is proceeding at a rapid rate in Georgia.

The Load-Dispatcher

IN the early days of electricity supply, the chief engineer of the station was in charge at the main switchboard. To this, all the generators and the supply mains were connected. The engineer was responsible not only for the condition of the machines, but also for putting them into operation at the right times so as to obtain the maximum economy. Now that many stations of very different types are linked together, a suitable staff and a 'load-dispatching' plant are necessary in order to run the system economically. The office and plant may be part of one of the stations or may be quite separate. A paper on this subject was read by Dr. Sleicher to the Institution of Electrical Engineers on May 3. He gave an account of modern practice in Germany and in other European countries of the supervisory control systems as applied to large interconnected supply areas. He showed how important the work of the load-dispatchers is to the prosperity of the undertaking. They must know the right number of machines to be started and the time required to start them. In the Berlin municipal works, for example, the period of preparation from the moment of the order of starting until the opening of the stop valve is from 8 to 35 minutes. The time from the opening of the valve until full speed is attained is from 15 to 90 minutes according to the size of the turbines. The time for the synchronising and switching on to the system is very short in comparison with the starting-up period. A sudden demand for power cannot be met by turbines. When surplus water-power is available it is most useful when peak loads have to be carried. Eleven pumping stations are already in use in Germany for this purpose.

Wind Tunnels for Aeronautical Research

THE Aeronautical Research Committee's "Reports and Memoranda No. 1569" (H.M. Stationery Office. 1*s*. net), recently issued, gives a description of the new open jet wind tunnel at the National Physical Laboratory, and also describes the preliminary model experiments carried out in order to ensure the most efficient aerodynamic performance from the actual tunnel. The results are a striking vindication of the exponents of the use of the principles of dynamical similarity in comparing the behaviour of objects of similar form but varying sizes. These principles offer a convenient, and often the only possible, way of investigating questions in aircraft design and aerodynamic problems generally. Two model tunnels were made, the second based upon experience with the first—and also the compressed air tunnel—in matters of the shape of the ducts, shape and positions of guide vanes at the corners, design of air screws, etc. The power factor of the models was subject to a large scale effect. At the jet speed mainly used during the experimental work, namely, 50 ft./sec., the power factor was 1·8. The variation with Reynolds's number indicated that a full-scale power factor of about 2·6 might be expected. The full-scale tunnel now completed has exactly equalled expectations. The distribution of velocity in the jet is as good as was anticipated, and the power factor has the predicted value of 2·6. The elliptical nozzle of the tunnel has a horizontal major axis measuring 9 ft. 1½ in., and a minor axis of 7 ft. 0 in., and an input of 375 B.H.P. at the airscrew yields an airspeed of about 210 ft./sec. in the jet. The final model is being used for further small-scale research.

Problems in Deep-Level Mining

THE Association of Mine Managers of the Transvaal (Johannesburg) has just issued an interesting volume entitled "Some Aspects of Deep Level Mining on the Witwatersrand Gold Mines with Special Reference to Rock Bursts". The volume contains six papers by leading practical authorities on Witwatersrand mining, together with the discussions of these papers and an appendix specifically dealing with rock bursts. In spite of the title, rock bursts are not discussed in all the papers submitted; thus, in the very first paper, dealing with mining on the Robinson Deep Mine, is the following statement with regard to rock bursts: "This is a subject of such importance that a detailed discussion of same is outside the scope of these notes". The other papers, however, deal with rock bursts at considerable length, although some of them confine their attention mainly to a class of rock bursts which are called "pressure bursts"; these are defined as follows by Mr. R. E. Mickel, the underground manager of the Durban-Roodepoort Deep Mine: "this type of burst includes bursts in the mined out areas, except punch bursts, and bursts on faces where the solid is not completely destroyed"; apparently this definition is accepted by everybody, but there seems to be a general feeling that that particular variety of rock burst which is known as a

pressure burst is fairly well understood by those who have to deal with these very dangerous phenomena. One short paper deals with "Rock Bursts Prevention", but it would seem that the author has not really succeeded in preventing these serious accidents. The volume may be strongly recommended to all interested in deep-level mining problems.

Missions in New Spain

INTEREST inspired by the archæology of Mexico and Central America is apt to divert attention from the study of the Indians themselves who lived in these regions, and the effect on them of the clash of cultures which arose out of the Spanish conquest, both at the time and in their subsequent history. It is, in fact, only comparatively recently that it has been realised that the customs and beliefs of the Indian of to-day present an unrivalled field for the study of syncrisis in culture and religion. The possibilities of such study are suggested, for example, by a recent publication of the Institut d'Ethnologie of Paris, "La Conquête spirituelle du Mexique", by M. Robert Ricard (*Trav. et Mem.*, 20), in which it is remarked that the failure of the Church to establish a native priesthood as part of the campaign of Christianisation has never ceased to affect the course of history in the country down to this day by segregating the native population, even though the Spaniards were never affected by the colour-line in the accepted sense. M. Ricard's able study of the Catholic missions in Mexico from 1523–4 until 1572, that is, from the first arrival of the mendicant friars, after the conquest of Cortez, down to the arrival of the Jesuits, is based on a careful study of early records. It has, as one side of the picture, the culture of the Indians whom the friars sought to convert, as seen through the eyes of writers such as Sahagun, who recorded native customs for the instruction of those whose duties called them to the work. M. Ricard's researches have placed the early work of the Church in a more correct perspective than has hitherto been possible.

Studies of American Social Areas

THE thoroughness and detail with which American investigators carry out their inquiries is well exemplified in a series of bulletins recently published by Cornell University Agricultural Experiment Station, dealing with the social and economic characteristics of various counties in New York State. In one of these bulletins written by Mr. H. C. Hoffsommer and entitled "Relation of Cities and Larger Villages to Changes in Rural Trade and Social Areas in Wayne County, New York", it is explained that the villages with a population of 500 persons or less have suffered severely from the competition of the larger villages. The smaller villages, however, have maintained their status better socially than economically, and it is interesting to note that the average distance travelled is shortest for church attendance and greatest for the purchase of women's dresses. The data show that social life at present is carried on in relatively small areas. That it will always be so does not follow, and a trend towards the uniting of small social areas into larger ones is evident. But the expansion of the social areas has been much less marked than that of commercial areas. This leads to the conclusion that although churches, schools, and other social and educational agencies may unite for better and more effective work, the areas which they can effectively serve will remain relatively small as compared to those of the more specialised economic services.

Showers of Fish

FOR more than two thousand years, occasional showers of fish are said to have occurred in various parts of the world, but especially in India, in stormy, or at least showery, weather. In the *Journal of the Asiatic Society of Bengal* (29, No. 1; 1933), Dr. Sunder Lal Hora discusses Indian examples of the phenomenon, and gives references to papers dealing with these, some of which appeared more than a century ago. He also considers various explanations that have been advanced, and obviously inclines to the one according to which the fish in such a shower are sucked up from a pond or river by a waterspout and are deposited on the ground when the waterspout collapses. There is on the face of it no obvious objection to the theory, for the waterspout does sometimes occur in India, when the funnel-shaped tornado cloud that occasionally depends from a cumulo-nimbus cloud passes over any inland sheet of water. Dr. Hora's paper is followed by one by S. N. Sen, who for a number of years was on the staff of the Meteorological Office, London. Sen examines the meteorological conditions over India at the time when a recent shower of fishes was reported from the Muzaffarpur District, Bihar, on July 10, 1933, and finds that they were such as would frequently give rise to very disturbed cyclonic weather and violent thunderstorms, and that some notably heavy rains occurred on the day in question. The theory favoured by Dr. Hora remains, however, to be proved. One is tempted to think that what has generally been *observed* has been heavy rain and afterwards many small fish on the ground, but not a shower of fish, and that the minds of native observers of the two separate phenomena have been affected by mythological beliefs that seemed to offer an explanation of what had been observed. Dr. Hora refers to such a myth (a Hindu myth) connected with the rain-god Indra, according to which the waterspout is the trunk of one of Indra's elephants (the rain clouds are believed to be his elephants), who are engaged in sucking water up from the underworld during a storm in which the funnel cloud appears.

Forest Fires

DURING last year's drought, fires caused considerable damage in plantations in Great Britain; also to the beautiful heaths and commons which form so picturesque a feature of certain English counties. This year, apart from official statistics, the reports in the Press afford evidence that this fire damage

persists. When forest conservation was introduced into the tropical and sub-tropical portions of the British Empire, fire protection was considered to be one of the first important steps to inaugurate. The success achieved in India in this respect is well known; but, efficient and energetic as the forest service of that country showed itself in the fine system of fire protection introduced into the State forests, it would never have achieved success without vigorous official support. A Science Service Mail Report (Washington, D.C., July 30) states that owing to the drought, there has been a 66 per cent increase in forest fires for 1934 over the average of the past three years. National and State forests have, it is said, become like tinder in a great many areas, and the smallest spark is sufficient to light them. In 1933, there were 140,722 fires, the area burnt being 43,889,820 acres, the total damage being estimated by the U.S. Forest Service at 60,274,960 dollars. If the number of fires increases at the same rate as already experienced this year, the totals will exceed those of 1933. Attention is directed to the fact that a sum of 75,000,000 dollars has recently been earmarked for the 1,300 mile shelter belt of trees extending from the Canadian border to Texas, and the work is expected to continue for ten years. A comparison of the annual expenditure on this new forest belt with the destructive losses from forest fires shows that eight times the money spent each year for the next decade on planting trees would barely equal the value of the loss by fire in 1933.

Field Museum of Chicago

THE Field Museum of Natural History, one of the most progressive in the world, has suffered from the adverse financial conditions of the times, which have brought about declines in the value of securities held in endowment funds and reduction in income from endowments, contributions and memberships. Schemes of expenditure have had to be very much curtailed and economies enforced, but the result has been a gratifying reduction of the deficit carried forward from the previous year. Part of the success was due to the influx of visitors to Chicago for the Century of Progress Exposition, for the museum visitors for 1933 numbered 3,269,390, an annual attendance exceeding that ever attained by any museum in the United States, and probably a high record for the world. The growing fame of the Field Museum has something to do with its success. Consider the two major exhibits opened to the public in 1933: one, the Chauncey Keep Memorial Hall containing sculptures representing the principal races of mankind, and the Hall of the Stone Age of the Old World, with its restorations of types of prehistoric men and phases of their cultures. Both these new halls are unique—no other institution has exhibits illustrating these subjects on the scale of the Field Museum. In the zoology halls there were added natural groups of African lions, gaurs or seladangs of Asia, Florida manatees, orang-utans, bower-birds, and many series not treated as natural groups. Expeditions and field work had to be avoided except where they were financed by special funds contributed for the purpose; even so, zoological collecting was carried on in Guadalupe Island, in Guatemala and in West Africa, fossil collecting in Colorado and the eastern States, and archæological excavations on the site of the Lowry ruin in south-western Colorado.

Agriculture in New Zealand

IN opening the annual Dominion Conference of the New Zealand Farmer's Union at Wellington, Lord Bledisloe, the Governor-General, reviewed some of the current problems of the agricultural industry. After expressing the view that in no other country has the farmer brighter prospects, he urged the need for 'planning' control if economic success is to be realised. The lack of uniformity that still exists in both the dairy and cattle industries of New Zealand is preventing the extension of markets, and the elimination of second-rate produce must be effected as soon as possible. This cannot be brought about by Government intervention or control, but lies in the hands of the farmers themselves. Comparison with successful agricultural countries, such as Denmark, shows that this type of self-organisation is the most satisfactory. Speaking with reference to the cattle industry, Lord Bledisloe deplored the continuation of the embargo imposed on the importation of British livestock. The measures adopted in Great Britain for the suppression of epidemics such as foot-and-mouth disease are so drastic, he said, that the risk of introducing this complaint into New Zealand is nil. On the other hand, the loss to their cattle industry (especially in view of the present hopeful prospect of a remunerative trade in chilled beef and bacon pigs) is a very serious matter. In general, the outlook for the future is a hopeful one, but harmonious co-operation between town and country, factory and farm must be achieved if a lasting prosperity is to be assured.

Abattoir Design

A REPORT on abattoir design has recently been issued (Economic Series, No. 40. H.M. Stationery Office. Price 1s. net) by a technical committee appointed by the Ministry of Agriculture and Fisheries last December to consider the output, structure, layout and equipment of factory abattoirs. The Committee recommends that the principal characteristics of a factory abattoir should be single control, specialisation of labour, continuous process, the killing being spread fairly evenly over at least four days of the week, and a uniform condition and appearance of the finished product in place of the variations at present existing in the condition not only of the meat but also of the by-products. The Committee prefers a multi-floor factory abattoir to the single floor type found in nearly all the public abattoirs in England, on grounds both of hygiene and economy. It is recommended that in order to raise the general level of the condition of home-killed meat, all the meat and red offals should be adequately cooled before removal. Provision should also be made for

the production of dripping, sausages, skins, tripe and calves' feet, tallow, meat meal, blood manure, and animal glands for medicinal purposes. In conclusion, the Committee suggests that the difficulties of adjusting the slaughtering charges and the prices of by-products retained at the abattoir for processing might be minimised by leasing the abattoirs to slaughtering and by-product companies or associations. The local authority would thus be relieved of the difficulty of fixing service charges and yet could reserve to itself the right of general supervision.

Generic Names of British Insects

UNDER this title, the Council of the Royal Entomological Society of London has decided to issue, in parts as completed, a work designed to promote stability in the use of scientific nomenclature as applied to the insects of Great Britain. The scheme has been entrusted to a Committee on Generic Nomenclature, under the chairmanship of Sir Guy Marshall, with the assistance of the entomologists at the British Museum (Natural History). The terms of reference involve the preparation of "lists of scientific names to be fixed as genotypes of genera of British insects with a view to the suspension where necessary of the law of priority in respect of those generic names". The separate orders of insects are being dealt with by small panels of specialists acting as sub-committees of the central committee. The first list of generic names to be published under this scheme is entitled "The Generic Names of the British Rhopalocera with a Check List of the Species" (Feb. 1934) by Mr. Francis Hemming, and is to be obtained, price 3*s*. 6*d*., from the Society at 41, Queen's Gate, S.W.7. In this publication, the authority for fixing the genotype is given in each case, followed by the chief synonyms and the accepted names of the British species, for each genus concerned. There follow, wherever necessary, notes on special questions of nomenclature that may arise. In the case of four generic names, namely, *Argynnis*, *Vanessa*, *Strymon* and *Colias*, it is contended that the strict application of the rules of nomenclature should be suspended since, otherwise, it would involve the disturbance of these long-established names to no real advantage. The whole undertaking should prove a useful guide to all entomologists and a strong incentive towards the attainment of uniformity.

Value of Experiments on Animals

THE eighth Stephen Paget Memorial Lecture of the Research Defence Society, on "Experiments on Man", delivered by Prof. J. Barcroft, appears in *The Fight against Disease*, No. 3, 1934. The question whether the results of experiments performed on animals can be regarded as being applicable to man is discussed. It is concluded that in a great many cases the relevant information can be obtained from animal experiments. In certain instances, it may be necessary to perform the experiments on man, as in the elucidation of sensation and mental performances, and in the communication of disease when animals are unaffected by the virus. Attention is directed by the treasurer to the need for increased financial support for the Society.

Announcements

THE Trustees of Herbert Spencer have in the Press a book by Dr. J. Rumney on sociology, giving an account of the part Spencer played in founding the science, and showing to what extent his views have guided later scholars. The book will be published by Messrs. Williams and Norgate, Ltd., in the early autumn.

AT the annual general meeting of the Lister Institute of Preventive Medicine, held on May 30, the governing body presented the Institute's fortieth annual report. In addition to items concerning administration and finance, the Report gives a survey and summary of the scientific work carried out in the various departments during the year, forming a record of much valuable research. The Institute also houses the National Collection of Type Cultures, a collection of authenticated cultures of bacteria and fungi, which are available for those who may require them.

THE British Federation of University Women, Crosby Hall, Cheyne Walk, S.W.3, has issued and published a revised and enlarged second edition of "A List of International Fellowships for Research" (Price 2*s*.). The purpose of the book is to provide both men and women graduate students and research workers in nearly all countries with information concerning the opportunities open to them for carrying on their work in other countries by means of travelling fellowships or scholarships. Most of the fellowships listed are open equally to men and women, but those restricted to either sex are distinctively marked.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in mining at the Chesterfield Technical College—The Clerk to the Governors, Technical College, Chesterfield (Sept. 24). A chief lecturer in electrical engineering at the West Ham Municipal College, Romford Road, Stratford, E.15—The Principal (Sept. 27). A chief veterinary officer for the North Riding of Yorkshire County Council—The Clerk to the County Council, County Hall, Northallerton, Yorks (Oct. 1). A resident tutor in physics and mathematics at Borough Road College, Isleworth, Middlesex—The Principal. An assistant lecturer in education (especially in science subjects) at University College, Exeter—The Registrar.

ERRATUM. By a regrettable mistake, the Hardy Memorial Lecture at Aberdeen was referred to in early issues of NATURE of September 15, p. 411, as having been delivered by Sir Frank Heath. The lecture was, of course, given by Sir Frank Smith, whose name appears correctly in later issues.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spectrum of Chlorophyll

SOME knowledge about the mechanism of 'assimilation' may probably be gleaned from a detailed picture of the atomic processes involved in the absorption of light in dissolved chlorophyll. As I have not been able to find sufficient *quantitative* data on this subject in the existing literature, I have made some rough measurements to this purpose.

Samples of chlorophyll *a* and *b*, kindly put at my disposal by Prof. Stoll of Basle, were dissolved in alcohol (10 mgm. in 100 c.c.). Absorption measurements were then made with a König-Martens spectrophotometer at different concentrations (10^{-4}–10^{-5}). The results, for which no high precision is claimed, are partly shown in Fig. 1.

As is well known, both chlorophylls show a strong absorption in the red part of the spectrum accompanied by a weaker absorption in the yellow and green part. (To the right of the main peak in Fig. 1 a weaker maximum is to be seen for both chlorophyll *a* and *b*. A closer examination reveals *three* of these maxima for chlorophyll *a* at distances roughly 1, 2 and 3 times 1200 cm.$^{-1}$ from the main peak, and *two* for chlorophyll *b* at distances 1 and 2 times 1400 cm.$^{-1}$. They are probably related to vibrational levels.) The whole of this absorption, extending from about 680 mμ to 500 mμ, will be termed here the 'red band'. In addition, a 'blue band' is present in both cases, beginning at about 500 mμ with chlorophyll *b* and 460 mμ with chlorophyll *a*. Finally one or more 'ultra-violet bands' seem to exist. In the ultra-red one very weak band ($f < 0{\cdot}002$) at 3 μ has been found by D. van Gulik (*Ann. Phys.*, 46, 147; 1915). It does not necessarily belong to the same molecular group as the other bands.

We shall, in the first place, be concerned with the red band. Its 'oscillatory strength' or 'number of absorption electrons per molecule' may be calculated from the integrated absorption as follows:

$$f = \frac{mc^2/\pi e^2}{N}\int d\left(\frac{1}{\lambda}\right)\frac{\log I_0/I}{\log \varepsilon} = \frac{1{\cdot}13 \times 10^{12}}{6{\cdot}06 \times 10^{23} \times 10^{-4}/902}\int d\left(\frac{1}{\lambda}\right)\frac{\log I_0/I}{0{\cdot}434};$$

where N is the number of molecules per c.c., 902 is the molecular weight of chlorophyll *a* (907 for *b*); m, c, π, e and ε ($=2{\cdot}718$) are well-known constants. The result is $f=0{\cdot}24$ for chlorophyll *a* and $0{\cdot}22$ for chlorophyll *b* ($0{\cdot}13$ and $0{\cdot}11$ respectively for the main peak alone; from F. Perrins' measurements on the polarisation of the fluorescent radiation (*Ann. de Phys.*, 12, 169; 1929) the same value may be deduced: $f = \tau_0/3\tau = 0{\cdot}126$). The values of f for the blue bands were roughly estimated to be about 0·3 or a little more.* These high numbers prove conclusively that the absorption is not due to ionic movement alone but that an *electron* is lifted to a higher level too.

As the *a* and *b* spectra are not essentially different, we shall henceforward refer to them together. The *whole* red band (including its yellow and green tail) but *not* the blue or ultra-violet bands, may be produced in fluorescence by irradiating with light of a sufficiently short wave-length. The main peak alone appears when excited by light of its own wave-length (600–680 mμ produced by filters or prism). By comparison with a mastix emulsion (assumed to scatter without true absorption) it was found that for this red light the yield (fluorescent to incident radiation) is of the order of magnitude 10 per cent; for blue light it was less.

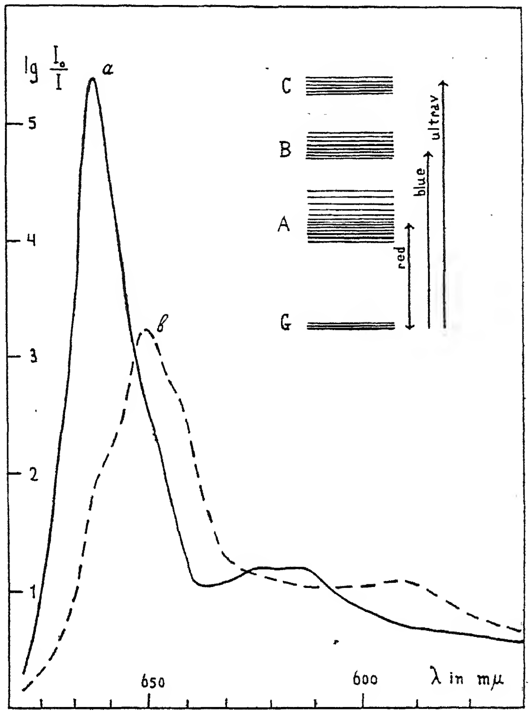

FIG. 1. 'Red' absorption band of chlorophyll *a* (full curve) and *b* (broken curve). Logarithm of incident to transmitted intensity for 1 cm. layer of 1 mgm./10 c.c. alcoholic solution. In the corner: Diagram of energy levels and transitions corresponding to absorption and fluorescence bands.

These facts may be explained by assuming a system of energy levels as indicated diagrammatically in Fig. 1. The electron may jump from its ground state G to at least three different higher levels, A, B and C. These electronic levels are further subdivided by the accompanying ionic vibrations, whilst the different 'rotational levels' are smeared out by the interaction with the surrounding medium. A further essential feature of this picture is the assumption that in state A the electron has only a moderate chance of losing its surplus energy without emitting radiation, for example, by collisions with the surrounding medium, so that there is a reasonable probability (10 per cent) for it to fall back with emission of light. In the higher states the converse is true. To explain this difference we may, for example, suppose that in state A the electron keeps more 'inside' the molecule. An alternative but less plausible explanation would be to ascribe a high probability ($f \gg 0{\cdot}3$) to the transition BA. It would

* For comparison some rough values I have determined for other substances may be quoted: iodine in carbon disulphide (green band), 0·016; potassium permanganate in water, 0·05; oxyhæmoglobin (double peak between 600 mμ and 500 mμ only), 0·33 (see also R. A. Houstoun, *Proc. Roy. Soc.*, 82, 606; 1909).

be worth while to look for the corresponding emission band ($\lambda = 1–1 \cdot 5\ \mu$) in fluorescence.

Chlorophyll is capable of assimilation only if it is in a special state, as is the case in living plants. Mr. K. Meyer, of Zurich, informs me in a private letter that he has probably succeeded in producing solutions *without* loss of assimilating activity. At any rate it may be presumed that the active state is not *very* different from the free state. So an application and elaboration of the preceding considerations does not appear to be out of place. Slight changes in the spectrum will of course accompany the transition to the active state; especially a decrease of fluorescence yield is to be expected as the energy of state A is now used for the chemical process.

J. A. PRINS.

Groningen.
Aug. 9.

Science and Psychical Research

As there has been some publicity over the resignation of the various scientific men who originally consented to serve on the Research and Consultative Committees of the International Institute for Psychical Research, and as the chairman of this body has made in print various assertions on the matter, we feel it desirable to give a brief statement of the facts.

We were originally approached by Dr. Fraser-Harris, the physiologist, who told us that this new organisation, of which he had been asked to be the "whole-time Research Officer", was intended to investigate questions of supernormal psychology by scientific methods, and that its supporters intended to raise large sums of money for this purpose. On these grounds we allowed our names to be used. Nothing further occurred until a public appeal was printed in the *Times* of April 7, 1934. An advance copy of this was supposed to have been sent to the scientific personnel, but it did not reach them until April 8, so that the members of the Consultative Committee were not notified of its impending appearance. At an early date, Dr. Fraser-Harris clearly saw that he was not to be allowed to direct the campaign for publicity in the manner and place which he considered best. The appeal was couched in such terms that we felt it necessary to resign from any connexion with the Institute. Some resignations were sent in at once, others after correspondence with the Institute. The chief ground for our resignation was the wholly non-scientific attitude thus revealed, for example, the statement that the Institute would at first concentrate on making the *proof* of survival its primary object. Unwarranted attacks on other bodies concerned with psychical research also contributed; and finally the fact that no members of the scientific personnel were consulted in framing the appeal or laying down policy did not augur well for the carrying on of the Institute on a scientific basis.

We would also like to record our strong disapproval of the treatment accorded to Dr. Fraser-Harris. After ten months without any remuneration except reimbursement of postage expenses, he was offered a small sum for one year and asked to "get to work" in the séance-room of the London Spiritualist Alliance (!), no mediums or scientific apparatus being provided, much less the laboratory originally proposed. By May 28, conditions had become so impossible that he resigned, having given eleven months' service, which interfered materially with his other work. A subsequent attack on him by the chairman of the Executive Committee of the Institute in *Psychic News* was abusive in tone, and contained a number of inaccurate statements.

We think it worth while to record these facts publicly, as they show the difficulty of scientific men collaborating with professed 'spiritualists', as were all those actively concerned with the inception of the Institute. They appear either to have no idea of what constitutes scientific method, or to have thought that they could obtain a dummy committee of scientific workers to confer scientific respectability on a propagandist enterprise. We are of the opinion that the investigation of so-called 'supernormal' phenomena is a very fruitful field for scientific research; but to secure the new knowledge we need an intelligent co-operative attitude, not only on the part of those who approach the subject from the scientific side, but also of those who approach it from the side of spiritualism (spiritism).

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E. W. MACBRIDE.

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Determination of Dipole Moments in Solution

RECENT work on the estimation of dipole moments in solution, particularly by Müller[1] and Jenkins[2], has shown that, contrary to that which was formerly believed, the apparent dipole moment of a substance in solution is not independent of the non-polar solvent in which it is measured, although in the case of each solvent the polarisations of the solute are extrapolated to infinite dilution. The apparent dipole moment decreases as the dielectric constant of the solvent increases. As a further consequence of this effect, the temperature variation of the polarisation at infinite dilution in a given solvent leads to a value of the moment which is too low, since the dielectric constant of the solvent decreases as the temperature rises.

Several attempts have been made to correlate these results with the moments measured in the vapour state, and to deduce from measurements in solution, a moment which shall be independent of the solvent.

Sugden[3] has shown that if measured values of the molecular polarisability P_2 in solution are plotted against the corresponding values of the volume polarisability $(\varepsilon - 1)/(\varepsilon + 2)$ for solutions of benzonitrile, nitrobenzene and chlorobenzene in a number of non-polar solvents, the points for each substance all lie near a straight line, the slope of which is approximately equal to $P\mu$, that portion of the total polarisation which is due to the permanent dipoles.

During the discussion at the symposium held by the Faraday Society at Oxford last April, I pointed out that if the formula suggested by Prof. Sugden,

$$P_{\text{liq.}} = \alpha + P_{\text{gas}} - P\mu\,(\varepsilon - 1)/(\varepsilon + 2),$$

were of general applicability, then $P_{\text{liq.}} \sim (\varepsilon - 1)/(\varepsilon + 2)$ lines for the same solute at different temperatures would converge to a common point at $(\varepsilon - 1)/(\varepsilon + 2) = 1$, and that the moment could be obtained from the slopes of the lines.

There were then no data to test this. I have now measured the polarisation of nitrobenzene in solution in decane (di-isoamyl) and in p-xylene at concentra-

tions up to nearly 28 per cent by weight of solute and at 20° intervals from 20° to 120°.

The values of P_2 at each temperature when plotted against $(\varepsilon - 1)/(\varepsilon + 2)$ give straight lines which, when produced, meet at a common point at $(\varepsilon - 1)/(\varepsilon + 2) = 1$. The slopes of these lines yield the following moments in Debye units ($D = 1 \times 10^{-18}$ E.S.U.).

t	μ	t	μ
20°	4·30 D	80°	4·25 D
40°	4·30 „	100°	4·22 „
60°	4·25 „	120°	4·19 „

The average is 4·25 D, which is in good agreement with the value 4·23 D for the vapour recently published by Sugden and Groves[4]. These results will shortly be published and discussed in more detail elsewhere. F. FAIRBROTHER.

The University,
Manchester.
Aug. 6.

[1] Müller, *Phys. Z.*, **33**, 732; 1932. **34**, 689; 1933. **35**, 346; 1934.
[2] Jenkins, NATURE, **133**, 106, Jan. 20, 1934. *J. Chem. Soc.*, 480; 1934.
[3] Sugden, NATURE, **133**, 415, March 17, 1934.
[4] Sugden and Groves, *J. Chem. Soc.*, 1094; 1934.

Cyclic Components of Paraffin Wax

CRYSTALLOGRAPHIC considerations have led Mr. Yannaquis[1] to the conclusion that some of the components of paraffin wax belong to the naphthenic series. In the course of our work on the composition of asphalts derived from paraffinous petroleum[2], similar conclusions were reached with regard to some fractions of wax, which had been prepared by solvent extraction from petroleum asphalts.

Successive crystallisations from pyridine and ether, followed by an ultimate crystallisation from benzene, enabled us to separate the bulk of the paraffin wax into four fractions of different melting points. Elementary analysis of those fractions, carried through most carefully, proved that there is always a certain deficiency in the hydrogen content as required by the formula $C_n H_{2n+2}$.

Fraction	1	m.p. 76° C.	C: H ratio corresponds to	$C_n H_{2n+1}$
„	2	„ 63° C.	„	$C_n H_{2n}$
„	3	„ 57° C.	„	$C_n H_{2n-2}$
„	4	„ 50° C.	„	$C_n H_{2n-3}$

It is obvious that the first fraction is to be considered as a mixture of true paraffins with some cyclic hydrocarbons which are most probably the chief components of the remaining fractions. The iodine number being rather small and amounting to 5 only, the occurrence of cyclic hydrocarbons in undistilled paraffin wax seems to be adequately established. The decrease of the hydrogen content of the fractions is followed by an increase of the specific gravity from 0·798 at 80° C. to 0·817 at 80° C. and of the refractive index n_D^{80} from 1·4470 to 1·4558. Another fact pointing to the cyclic constitution of these hydrocarbons is the slope of the temperature-viscosity curve, which is markedly steeper in the case of fractions with a smaller hydrogen content.

J. MÜLLER.
S. PILAT.

Laboratory of Petroleum Technology,
Lwow, Poland.
Aug. 1.

[1] *Ann. Combustibles liquides*, **9**, 295; 1934.
[2] *Asphalt und Teer*, **32**, 708; 1932. **33**, 421; 1933.

Red 'Water-Bloom' in South African Seas

WHILE the R.R.S. *Discovery II* was refitting in Simonstown, a remarkable profusion of a red 'water-bloom' was observed in Simons Bay. The sea close inshore was strongly discoloured, large areas appeared blood-red. These were often sharply marked off from other areas in which the sea was of a more normal greenish hue. Motor-boat runs indicated that the red water extended along the greater part of the east coast of Cape Peninsula on July 15 and 16, 1934. Similar phenomena were observed during a previous commission, once early in June 1930 on entering Table Bay from the north, and on several occasions in False Bay.

Microscopic examination showed that the discoloration was caused by myriads of ciliate Protozoa, belonging to *Mesodinium* or some closely allied genus. They instantly disintegrated when ordinary fixing methods were attempted, and moved too fast to permit of detailed examination when alive. The general form was as indicated in Fig. 1, a globular mass of reddish granules contained within a trans-

c. 40μ

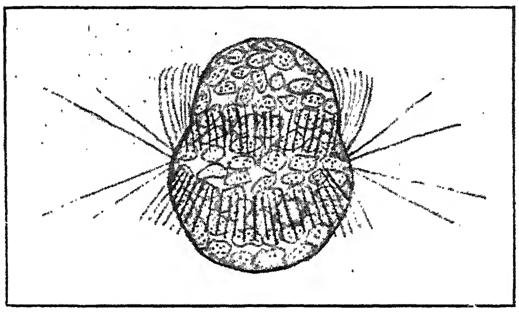

FIG. 1.

parent pellicle, provided with a double ring of cilia. They suddenly perished after brief exposure to strong light; all structure was lost instantaneously and the red granules turned yellow, and later, green. This was evidently the cause of the green scum that accumulated at the tide line all along Cape Peninsula at the time. Probably the granules are symbiotic zoochlorellæ, for they appeared to maintain an independent holophytic existence for some time after the death of the ciliates. These organisms approach the northern *Mesodinium rubrum* more closely than any other species described in the literature available, but Hamburger and von Buddenbrock's[1] figures are not adequate to determine whether it is indeed the same. So far as I can ascertain, ciliates have not previously been recorded as a cause of extensive discoloration of the sea.

A brief general account of the formation of 'water-bloom' by micro-organisms, sometimes thick enough to be destructive to the higher forms of marine life, appeared last year in NATURE[2]. Dinoflagellates appear to be the most frequent cause[3,4], but euglenoid flagellates have also been known to form it[5]. Off South Africa, *Noctiluca scintillans* is mentioned as a cause of 'red water' in summer. Unfortunately, all our observations have been made between May and October when we have rarely obtained *Noctiluca* in large numbers, but I suggest that further study of 'red water' round the Cape, particularly in relation

to meteorological and hydrological conditions, would well repay local naturalists. A very rich mixed plankton of Diatoms, *Ceratia* and Copepoda, was present when the 'red water' invaded Simons Bay; rotifers were feeding upon the ciliates, the dominance of which was beyond question, and other free-living Protozoa were also present. It is hoped that it will be possible to publish a general account of the discoloration of the sea by living organisms in the future.

T. JOHN HART.

R.R.S. *Discovery II*,
Cape Town.
July 26.

[1] Cl. Hamburger and von Buddenbrock, "Nordisches Plankton", 13.
[2] NATURE, 132, 253, Aug. 12, 1933.
[3] W. E. Allen, *Bull. Scripps Inst.*, 1, No. 15.
[4] R. Hirasaka, *Annot. Zool. Jap.*, Tokyo, 10, Art. 15.
[5] Hornell, *Madras Fish. Bull.*, 11, Rept. 2; 1917.

Phylogenesis of the Stridulating Organ of Locusts

IT is an interesting task in palæozoology to reconstruct the lineages on which recent and fossil groups have developed and, at the same time, to trace the general laws of phylogeny. Groups having developed a new and well-defined organ at a certain geological period are especially suitable for investigation from this point of view, if the palæontological record is complete enough. A good example is the evolution of the musical apparatus in the forewings of locusts. A very rich series, composed mostly of forms from the Lower Liassic of England and the Upper Jurassic ('Solnhofener Schiefer') of Bavaria is kept in the collections of the British Museum (Natural History), London. Many of these fossils belong to the Prophalangopsidæ, represented in recent times by a single Indian species which is still insufficiently known since there is only one specimen, *Prophalangopsis obscura*, Walker, preserved in the British Museum.

I have studied forty to fifty fossil relatives of this recent species. This very peculiar family flourished in the Jurassic. It was then that they developed their musical apparatus and gave rise to the modern families of Gryllidæ and Tettigoniidæ. The results of my investigations may be summarised as follows:

(1) The most primitive forms have no organ for producing sounds, though some of them might have had ears in the fore-leg. Their fore-wings have a primitive and variable venation. They lived in the Upper Palæozoic and later. Apart from the Prophalangopsidæ, they developed the Elcanidæ in the Triassic and the Jurassic, and the Gryllacrididæ which have persisted since the Upper Palæozoic. The modern Acrididæ also seem to have branched off here.

These primitive forms, when producing sounds by rubbing the fore-wings against each other, only added a new function to the normal function of the wing, which is flying; the existing organ (the wing) proved to be fit for an additional purpose.

(2) The second stage is represented by the Prophalangopsidæ. They have a musical apparatus *statu nascendi*, covering nearly the whole fore-wing of the male. The veins are strongly curved, and certain areas of the wing are elevated and others depressed, its surface thus being rough and stiff. The Mesozoic and recent Gryllidæ with their more highly specialised venation are doubtless descendants of Prophalangopsidæ. But the latter family also is ancestral to the modern Tettigoniidæ.

In this second stage, the fore-wings are distinctly adapted to the additional function of producing sounds. But still the wing, practically as a whole, served for the two functions; for flying quite naturally and for producing sounds by rubbing the radial, median, cubital and anal parts of one wing against those of the other wing. The wings were laid flat above the abdomen when at rest.

(3) One Prophalangopsid genus, *Cyrtophyllites*, Oppenh. of the Upper Jurassic, shows how the stridulating organ of modern Tettigoniidæ developed from that of the Prophalangopsidæ. The main part of the musical apparatus is restricted to the cubito-anal area, and the latter is the only part covering a corresponding part of the other wing. The fore-part of the fore-wing is folded down the sides of the body.

In the Tettigoniidæ still flourishing, these characters are much more stressed. The cubito-anal area in both fore-wings is highly modified, small and asymmetrical, and is restricted to the very base of the wing. The great advantage of this restriction of the stridulating organ is that—in accordance with the laws of levers—the animals were enabled to intensify the noise without using more power.

In this way, the structure of the fore-wing was consequently improved during geological times and adapted to the requirements of the new function, though the original function of flying was not lost in many of the locusts. But some of them reduced the wings so greatly that only the musical apparatus remained, and in these cases we are entitled to speak of a real change of function of the organ.

Thus the development of the stridulating apparatus of the fore-wing of locusts clearly explains how an organ may change its function and how unnecessary it often is to discuss whether the organ preceded the function or vice versa. If a function (for example, the production of sound) is older than its special organ (musical apparatus) it often can be shown that another organ (the fore-wing) is still older than the function in question and that the special secondary organ developed from this original one after the function had been changed.

Further results:

(1) The ear in the tibia of the fore leg is fully developed in the second (prophalangopsid) stage, and evidently older than the musical apparatus.

(2) The development described above is restricted to the male sex, but, in the Upper Jurassic and later, forms appear in which the females have certain male characters in the fore-wings.

(3) Some reversibility of evolution can be observed in the shape and venation of the wing.

FRIEDRICH ZEUNER.

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S.W.7.
Aug. 24.

Sensitivity of Dividing and Non-Dividing Cells to Radiation

IN his reply to the letter of Dr. Love published in NATURE of August 18, Dr. Mottram asks for an experiment which demonstrates the peculiar sensitivity of the premitotic cell to gamma radiation but at the same time disallows the prevention of mitosis as a measure of radio-sensitivity. This is the aspect of the problem to which we have particularly addressed ourselves, and we have found that a cell *in vitro* can be prevented from dividing by a dose of radiation which produces no recognisable effect

either on resting cells or on those already in the process of division. In our opinion this is a perfectly legitimate index of sensitivity.

We are now studying the effect of gamma irradiation upon the embryonic columnar epithelium of a chick embryo of two days' incubation, in which, as one of us (A. G.) has shown[1], the point in the cycle of division of any cell may be deduced from its form and position within the epithelium. All dividing cells, together with those about to divide, and those which have just divided, are arranged in a layer bordering the lumen. Resting cells (that is, non-dividing cells) are found away from the lumen towards the surrounding mesenchyme. When a resting nucleus is about to divide, it migrates towards the lumen and assumes a streamline form. When it reaches the lumen it becomes globular and then divides. The daughter nuclei retreat away from the lumen, and assume the streamline form in the reverse direction.

In the streamline nuclei approaching the lumen, chromosomes are already beginning to form, and it is this stage to which the term 'pre-mitotic' should be applied. By irradiating suitable embryos *in ovo* or explanted whole *in vitro* we can study the reaction of cells at each stage of the cycle of division to irradiation.

Small doses of irradiation have no effect on resting or on dividing cells, but cause an arrest of the mitotic cycle in premitotic cells in just the same way as we have already demonstrated for cells in tissue cultures; the migration towards the lumen still takes place, but the formation of the chromosomes is inhibited.

A heavy dose causes degeneration throughout the tissue, but always to a greater extent in the premitotic and dividing cells than in the resting cells. The exact distribution and degree of degeneration among cells in these three conditions of activity under different physical conditions have yet to be determined, but we hope shortly to publish our results and thus furnish the details for which Dr. Mottram has asked.

F. G. SPEAR.
A. GLÜCKSMANN.
A. F. W. HUGHES.
C. W. WILSON.

Strangeways Research Laboratory,
Hills Road, Cambridge.
Aug. 29.

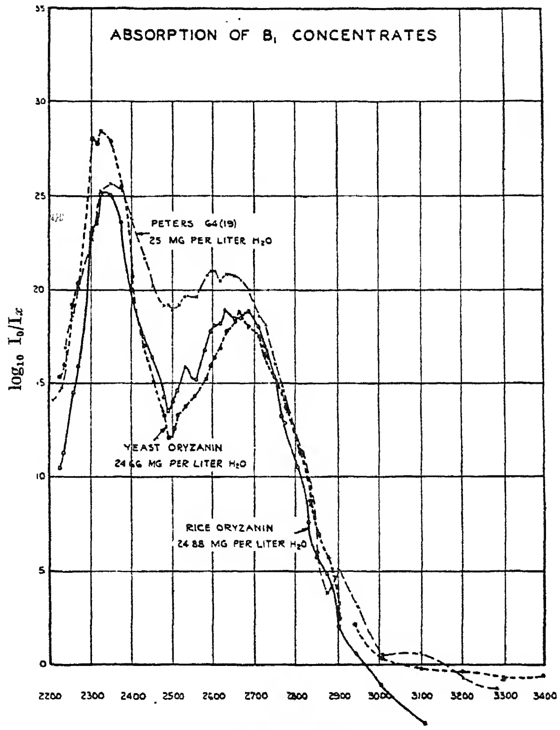
[1] *Z. Anat.*, 93, 1930.

Chemical Constitution of Vitamin B_1 as deduced from Ultra-Violet Absorption Spectra

IN earlier papers[1], we pointed out the correlation of absorption at 2600 A. with the activity of various B_1 concentrates and the probability that the active material is a purine or pyrimidine derivative as indicated by its apparent absorption maximum at this point[2,3]. The materials discussed in these papers[1] were impure concentrates. Peters and Philpot[4] concluded from studies of crystalline preparations made at Oxford that the maximum characteristic of B_1 is more probably at 2450 A.

Through their kind co-operation, we have been enabled to study during the past year two of Dr. Peters's crystalline preparations, as well as two from Dr. Ohdake, and three prepared by Dr. Seidell, in addition to several made in our own laboratory. The parallel biological and spectrographic assays of these materials again indicate a marked correlation between absorption at or near 2600 A. and biological activity. The absorption curves, some of which are reproduced here (Fig. 1), resemble those of cytosine[3], having maxima at 2650 and 2350 A. and extinction values of the correct order. Lack of correlation between absorption and activity at 2350 A. as well as at 2600 A. in the earlier materials studied was probably due to the presence of end-absorbing impurities in some of the concentrates. The present results indicate that the active material may be built around a pyrimidine of the cytosine type.

On the basis of preliminary experiments, we believe that the discrepancies between our results and those of Peters and Philpot may be explained as effects due to the solvents used. According to his published curve[5], Windaus's crystals gave still different results, having a single maximum at 2600 A. with little absorption in the short-wave region. It is possible to explain this by presuming that more than one of the pyrimidines can form the nucleus of the active molecule—uracil serving in the Windaus crystals, cytosine in the others. Windaus's early formula[5] for his crystals contains one less N (N_3) than the formulæ of van Veen or Ohdake (N_4), which is in agreement with this hypothesis (uracil has N_2, cytosine N_3).



Wave length—Angstroms.
FIG. 1.

Full details of these results and of investigations of the influence of full and filtered ultra-violet irradiation on B_1 crystals will be published elsewhere.

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Structure of the Ionosphere

In a recent paper, Appleton and Builder[1] mention a striking fact that on certain occasions, when the ionosphere is being surveyed by the 'pulse' method, there is a reversal in the times of arrival of the two magneto-ionic components into which the upgoing ray is split. They attribute this to differential group retardation, and it occurred to me a short time ago that this effect might throw some further light on a suggestion I have made previously[2], namely, that the whole intermediate space between the E and F layers is ionised to a value very little less than that of the top of the E layer.

I have made some approximate calculations of this group retardation, which indicate that a time delay sufficient to produce the effect noted by Appleton and Builder cannot be produced by a discrete layer 15–20 km. thick without assuming that the density of such a layer can remain constant at a certain value for an appreciable time to a limit of about 1 part in 10,000. If, however, the whole of this intermediate space is ionised, the limit becomes of the order of 10 per cent.

This seems to suggest very strongly that the ionisation of the whole of the intermediate region is comparable with that of the top of the E layer, and I hope to publish the results shortly; but, if this is the case, the group velocity throughout this region will be considerably less than its normal value in free space; and this may affect results derived from observations on the intermediate and F layers. In fact, it raised the question as to whether the 'shelves' have a real existence or merely arise as points of inflexion on a group-velocity curve, and this requires further consideration.

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Aug. 19.

[1] *Proc. Phys. Soc.*, **45**, 208.
[2] *J. Inst. Elect. Eng.*, **72**, No. 435, March 1933.

Chemical Separation of the Radioactive Element from its Bombarded Isotope in the Fermi Effect

Following the pioneer experiment of Fermi, it has been found by Fermi, Amaldi, D'Agostino, Rasetti and Segrè that many elements up to the atomic number 30, when bombarded by neutrons from a radon-beryllium source, are transmuted into a radioactive element which is chemically different from the bombarded element. In several cases of this type, they succeeded in separating chemically the active substance from the bulk of the bombarded element, and there is no inherent difficulty in getting any desirable concentration of the radioactive element.

They have not observed such chemical changes in elements above the atomic number 30, though many of these heavier elements show strong Fermi effects. For some of these, for example, arsenic, bromine, iodine, iridium and gold, they could show that the activity is carried by the bombarded element, which in the circumstances leads to the conclusion that the radioactive element is an isotope of the bombarded element.

In order to separate the radioactive isotope of the bombarded element from the bulk of the bombarded element, one has to find a new principle of separation. We have attempted to apply the following principle. If we irradiate by a neutron source a chemical compound of the element in which we are interested, we might expect those atoms of the element which are struck by a neutron to be removed from the compound. Whether the atoms freed in this way will interchange with their isotopes bound in the irradiated chemical compound will depend on the nature of the chemical compound with which we have to deal. If we work under conditions in which such an interchange does not take place, we obtain the radioactive isotope 'free', and by separating the 'free' element from the compound we can obtain any desirable concentration of the radioactive isotope.

We have applied this principle to iodine. Ethyl iodide has been irradiated and a trace of free iodine added to protect the radioactive isotope. By reduction and precipitation as silver iodide in water, it was easy to concentrate the activity so as to get from the precipitate ten times as many impulses of the Geiger-Müller β-ray counter as directly from the irradiated ethyl iodide[1]. Apparently a large fraction of the active substance could be extracted from the ethyl iodide. The quantity of the active element obtainable in the precipitate will naturally depend on the quantity of the compound subjected to irradiation.

This principle of isotopic separation has also been applied to some other elements which, like iodine, are transmuted into their own isotopes, and further experiments mostly with organic compounds are in progress.

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[1] *Proc. Roy. Soc.*, A, **146**, 483; 1934.

Activated States in the Spectrum of Copper Hydride

In addition to the well-known band system $^1\Sigma^* \rightarrow {}^1\Sigma$ in copper hydride, we recently reported[1] a new band system $^1\Sigma^{**} \rightarrow {}^1\Sigma$, the activated states $^1\Sigma^*$, $^1\Sigma^{**}$ forming a doublet ($\nu_e^* = 23431$, $\nu_e^{**} = 26369$), previously known in the spectra of gold hydride $\nu_e^* = 27658$, $\nu_e^{**} = 38231$). In the spectrum of silver hydride[3], $^1\Sigma^{**}$ has not been found, although its presence is indicated by irregularities in $^1\Sigma^*$.

Extending our analysis into the ultra-violet region in the spectrum of copper hydride (in emission), we were able to disentangle two new band systems, composed of P-Q-R-branches and forming $^1\Pi \rightarrow {}^1\Sigma$ systems, the constants of the $^1\Pi$-terms being given below:

	ν_0	B_0	γ_0
$^1\Pi^*$	27100	6,39	0,018
$^1\Pi^{**}$	27957	6,065	0,066

($\gamma_0 = \Lambda-$doubling coefficient).

A more detailed account will appear later.

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[1] A. Heimer and T. Heimer, *Z. Phys.*, **84**, 222; 1933.
[2] E. Hulthén and R. V. Zumstein, *Phys. Rev.*, **28**, 13; 1926.
[3] E. Bengtsson-Knave, Dissertation, Stockholm, 1932.

Absorption Spectrum of Oxygen at High Pressures and the Existence of O_4 Molecules

AT high pressures gaseous oxygen exhibits a large number of absorption bands between 12610 and 2200 A., similar to those of the liquid[1]. In order to establish the nature of these bands one of us together with Finkelnburg[2] commenced about three years ago to measure the dependence of the intensity of absorption at high pressures on the oxygen concentration and on the presence of foreign gases. Some results have already been published[2,3]. We now wish to report briefly on the most important recent results, since *all* the bands have now been classified in the ways described below, and because the absorption spectrum of oxygen has been investigated by other workers[4,5]. The complete account of this work with the relevant data will appear shortly in *Zeitschrift für Physik*.

From the variation of the absorption with the concentration of oxygen and with the addition of foreign gases, conclusions may be drawn as to the carriers or processes which are involved in the production of the individual bands.

1. If the absorption varies *linearly* with the O_2-concentration and is *not* influenced by foreign gases, it must take place in an (almost) undisturbed O_2-molecule.
2. If the absorption varies with the *square* of the O_2-concentration and is *not* influenced by foreign gases, two O_2-molecules must take part in the act of absorption: that is, a collision pair O_2–O_2 or a loosely bound O_4 molecule.
3. If the absorption varies with the *square* of the O_2-concentration and its intensity *is* influenced by foreign gases without change of structure in the spectrum the absorption takes place during the collision in *one* O_2-molecule, in which the selection rules may be altered by the collision.

Corresponding to these considerations we actually find *three* groups of spectra:

Group 1. Intensity increases *linearly* with O_2-concentration; no influence of foreign gases; bands from 10320 to 6890 A. Attributed to forbidden transitions $^3\Sigma - {}^1\Delta$ and $^3\Sigma - {}^1\Sigma$ in the *normal* O_2-molecule.

Group 2. Intensity increases with the *square* of the O_2-concentration; *no* influence of foreign gases; bands from 6300 to 3289 A. Since *two* O_2-molecules are involved, and *only* two, these bands definitely correspond to absorption by an O_4-molecule. These bands coincide with those which were suggested by Ellis and Kneser[4], on the basis of their term values, to be electron-combination terms between two O_2-molecules. The present experiments confirm this suggestion, since the bands possess the *necessary* physical characteristics.

Group 3. Intensity increases with the *square* of the O_2-concentration, and, at constant O_2-concentration, *linearly* with the concentration of foreign gas. The intensity varies with the foreign gas, without alteration in the structure of the spectrum, the effect increasing, at constant partial pressure, in the order He, Ne, A, N_2, CO_2. Bands from 2859 to 2440 A. followed by continuous absorption. These bands have been attributed by Wulf[6] to the O_4-molecule. In a previous paper with Finkelnburg[2] it was shown that the vibration terms converge to the dissociation energy of the O_2-molecule in normal atoms, which led us to suggest that the absorption takes place in *one* only of the colliding O_2-molecules. Evidence supplied by Warburg[7] on the influence of N_2 on the absorption led us to investigate the influence of other foreign gases with the above results, which confirm that suggestion. These bands therefore correspond to absorption by one O_2-molecule during the collision, by which it may be influenced, with either O_2 or a foreign gas molecule (or by loosely bound polarisation molecules O_2–X). A probable relationship of this system with the bands observed by Herzberg[8] in O_2 at 1 atm. will be decided by experiments now in progress.

Molar extinction coefficients for the various absorbing carriers can be calculated from these absorption measurements. The order of magnitude is 10^6 or 10^7 times smaller than the normal absorption (Schumann-Runge bands). The probability of the electron combination transition (group 2) must, on quantum mechanical grounds, be small compared with the probability of the normal transition. The values found for the molar extinction coefficients of group 2 therefore seem to us to be a further argument in favour of Ellis and Kneser's attempt to explain these spectra.

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[1] J. C. McLennan, H. D. Smith and J. O. Wilhelm, *Trans. Roy. Soc. Canada*, Sect. III, **24**, 65; 1930.
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[5] M. R. Guillien, *C.R.*, **198**, 1223; 1934.
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Heavy Water and Water of Crystallisation

THE statement made by Prof. Erlenmeyer and Mr. Gärtner in NATURE of September 1, that, by crystallising sodium sulphate from solutions containing a few per cent of heavy water, the latter is divided practically equally between the water of crystallisation and solution, is in harmony with experiments I carried out some months ago. To ascertain if heavy water normally present in ordinary water could be concentrated by crystallisation, several litres of warm saturated solution of sodium sulphate were cooled. The crystals that separated were heated and the refractive index of the expelled water was determined with the Pulfrich refractometer as this was thought to afford a sensitive method of observing any change in the composition of small quantities of water. The dehydrated salt was added to the original solution and a fraction again crystallised out. This process was repeated many times until the original solution was reduced to small bulk. No change in the refractive index could be detected, however, between the initial and final fractions from either crystals or solution. It does not appear possible, therefore, to concentrate heavy water in this manner.

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Research Items

The Ainu. A Research Committee of the Anthropological Section of the British Association appointed to carry out research on the Ainu on the basis of work done in Yezo by Dr. N. Gordon Munro, reported at the Aberdeen meeting. Dr. Munro finds that there are differences in custom and belief among the islanders owing in part to tribal conflict and lack of union in ancient times and owing in part to the clash of culture between Ainu and Japanese in modern times. In the majority of Ainu communities the old mode of life has changed, and hunting is practically a thing of the past. Inheritance and authority are patrilineal and marriage is patrilocal. Descent, however, is strictly matrilineal and exogamy is strictly enforced. The mother's brother has a voice, but not a decisive voice, in the selection of a husband for her daughters, and is said still to have some authority over her children. Dr. Munro has discovered that every woman wears a secret belt, and his investigations of the custom seem to support the statement that totemism exists among the Ainu, for which, however, there hitherto has seemed to be but little evidence. Each of these girdles or belts is supposed to have been the gift of a special spirit. The varieties of belts examined up to the present are attributed to *Kamui Fuchi*, who authorises other *Kamui* to bestow it, or to other *Kamui* identified variously with a bear, wolf, grampus (the chief sea deity), a hare, fox or deer—all females. It is found that it was forbidden to marry anyone of the same 'belt', the objective criterion of the clan, the penalty for infringement being death, later commuted to a fine and a compulsory shortening of the belt. Formerly the levirate was a general custom, signified by a special name, 'wife-lifting'. Two brothers might not marry two sisters. The sororate and marriage with a deceased wife's sister were forbidden, and the children of two sisters might not marry, though cross-cousins might, unless their mother had the same belt. The belt is the one criterion by which the Ainu decide all questions of marriage.

Palæolithic Caves in Derbyshire. In a report presented at Aberdeen of the Research Committee of the Anthropological Section of the British Association on the exploration of caves in Derbyshire, Mr. Leslie Armstrong states that during the past year an additional 15 ft. of the rear passage of the Pin-Hole Cave, Cresswell Crags, has been examined. The purpose of the excavation was to prepare a section of the deposits down to bed-rock for permanent exposure. No part of this section of the cave exceeds five feet in width, and in places it is not more than two feet wide; but progress has been slow on account of a layer of hard crystalline deposit 9–12 in. thick, which crowned the deposit and the numerous slabs of rock cemented into it. The stratification has been well defined throughout. Artefacts were more numerous than was expected. Tools of quartzite, crystalline stalagmite and limestone occurred in all three Mousterian levels. Two finds of special interest were a bone tool, 2 in. long, roughly triangular in form, which was cut into two prongs, and what appears to be a bone 'bull-roarer', $3\frac{1}{4}$ in. long and $\frac{7}{8}$ in. wide, of pointed oval form, perforated near one end. In comparison with other portions of the cave, animal remains were less numerous, and no additions to the fauna have been made. Mr. T. Petch reports on fungi occurring on flies collected by Mr. Armstrong in Pin Hole Cavern. Five species of fungi have been collected of which *Hirsutella*, parasitic on *Blepharoptera*, is a new species. It occurs in two forms. In one it first forms discontinuous brown patches of mycelium on the body of the insect, and afterwards erect fuscous clavæ up to 8 mm. long. In this condition, the fungus is fertile. In the second it develops into long hair-like strands, 8 cm. long, and is usually sterile. Specimens of *Stibella Kervillei*, Quel., first recorded in Britain by Mr. Armstrong in 1923 from the Creswell Caves, demonstrate that this fungus is not parasitic on insects as was thought, but is parasitic on another fungus, a *Hirsutella*.

Extinction of the Bird of Providence. New light regarding the extermination of this petrel, *Pterodroma melanopus*, has been revealed in a recently discovered contemporary account of the slaughter of the birds on Mount Pitt, Norfolk Island, in the early days of the settlement of New South Wales (Gilbert Whitley, in *Australian Zoologist*, 8, 42; 1934). The account is contained in a manuscript diary, kept by Lieut. Ralph Clark of the Royal Marines, which is preserved in the Mitchell Library, Sydney. Clark was appointed Quartermaster-General and Keeper of the Public Stores, and in this capacity he kept a conscientious tally of all the petrels or "Mount Pitt Birds" killed by the marines, sailors and convicts from day to day. The records of numbers show that in April 1790, 13,251 birds were killed, in May 82,321, June 70,699, part of July 5,091, so that from April 10 to July 10, 170,000 were slaughtered. Capt. John Hunter stated in the same year that Mount Pitt was crowded with the birds, and as full of holes as any rabbit-warren, and on May 2, Clark writes: "The Birds of mount Pit last night were so thick that the [*sic*] came down a little after sunset like a shower of hail. My servant was there and kil'd himself 193 Birds it is a great Blessing that we have these Birds in such abundance"; and on May 9, after 4,783 birds had been brought in, "long may this Blessing continue".

Hawaiian Oribatid Mites. Bulletin 121 of the Bernice P. Bishop Museum (Honolulu: 1934) consists of a contribution by Mr. A. P. Jacot entitled "Some Hawaiian Oribatoidea". In reviewing the taxonomic character of the superfamily, the author lays special stress upon the importance of the bristles and their arrangement. These offer an untouched field for the study of evolution as expressed in structure. In the course of these studies it has been found essential to name each bristle, or pair, since they hold radically different positions in different subfamilies. In addition to describing a number of new species of these mites, the author discusses at some length the various natural agencies that may account for their distribution. Principles governing the geographical distribution of large animals cannot be applied on the same basis to a microfauna. In the latter connexion, the influence of wind, birds, ocean currents and driftwood, and other agencies are taken into account. The paper is illustrated by sixteen plates portraying structural characters of various species.

The Alizarin-KOH Method of Staining Vertebrate Skeletons. With reference to paragraphs on this subject

which appeared in Nature of Feb. 4, 1933 (vol. 131, p. 171) and March 24, 1934 (vol. 133, p. 465), Mr. M. Rahimullah and Prof. B. K. Das write to point out that their paper (*J. Osmania Univ. Coll., Hyderabad, Deccan*, 1, 1–3; 1933) presented the first account of the adaptation of the alizarin-KOH method to the preparation of skeletons without the surrounding soft parts; that the suggestion of xylol as an alternative fluid for the preservation of such skeletons is new, as is also the statement that, in xylol preparations, a paste of amyl acetate and gelatin will hold together small bones which may have become separated by accident.

Distribution of Sex-Factors in the *X*-Chromosome. While it is now well recognised that the *X*- and *Y*-chromosomes furnish a basis for sex determination in many animals and plants, yet the question is still debated whether in particular cases a single sex factor or a series of factors in the *X*-chromosome are involved. Dobzhansky and Schultz (*J. Genet.*, 28, No. 3) have made an important contribution to this problem by an investigation of the sex-determining genes in the *X*-chromosome of *Drosophila*. Their method was, by the use of X-rays, to fragment the chromosomes and produce individuals with duplications and deficiencies. Fragments of known length both genetically and cytologically were added to males, females and intersexes of known constitution by crossing, and in this way the effect on the expression of sexual characters of adding a certain section of the *X*-chromosome could be studied. Intersexes were found to be especially sensitive to small variations in their sexual balance. Duplication or deficiency of the long inert section of the *X*-chromosome had no effect on the type of intersex, but duplication of any other portion produced a shift towards femaleness. Deficiency of the extreme left-hand end produced a shift towards maleness. The amount of the shift towards femaleness was roughly proportional to the cytological length of the duplication. The conclusion is reached that the *X*-chromosome contains numerous female modifiers scattered more or less evenly along all its parts except the inert region. The sex-determining rôle of the *X*-chromosome is the sum of all these effects. The authors believe that selection has tended to accumulate such factors, while in such organisms as frogs and fishes a single sex factor may still be present because they have more recently changed from a hermaphrodite to a diœcious condition.

Absorption of Manganese by Plants. A valuable contribution to the literature on the effects of manganese in plant growth appears in a recent paper by Carsten Olsen (*C. R. Trav. Lab. Carlsberg*, 20 (2), 1–34; 1934). A survey of the manganese content of leaves from a number of land plants from natural soils of different *p*H values shows that increase in soil acidity is accompanied by increased absorption of manganese, due presumably to the increased concentration of soluble manganese salts in the soil solution. Plants from basic soils show a very small manganese content. Iron content, on the other hand, seems to bear no consistent relationship to hydrogen ion concentration. Similar results were obtained with artificial soils in pot experiments with barley and buckwheat. Plants grown in water cultures of different *p*H but constant manganous sulphate concentration show a maximum manganese absorption at *p*H 6–7. The absorption increases with increase of manganese concentration in the medium. Manganese is probably absorbed as manganous ion, manganous salts being stable in acid soil. Hence water and swamp plants contain large amounts of manganese, even when grown in a neutral or basic medium, provided the latter is deficient in oxygen and oxidation of manganous salts to manganese dioxide is retarded. Plants grown in cultures free from manganese do not develop chlorosis, which seems to depend rather on the ratio of iron to other absorbed ions, but suffer from 'grey speck disease'. When developed in basic soils (for example, by oats), the disease is less serious in moist or clay soils where access of oxygen is diminished.

Minerals of Kimberlite. In a paper read before the Geological Society of South Africa on April 16, 1934, Prof. S. J. Shand presented an admirable study of the minerals occurring in kimberlite and their relative proportions. He finds that enstatite is by far the commonest pyroxene, probably ten times as abundant as all the others put together. Chrome-diopside comes next, and after it a pale green diopside possibly holding a little of the jadeite molecule. These minerals, together with garnet, are xenocrysts that have been picked up and enclosed by the kimberlite magma, since out of the thousands of grains examined not one showed a trace of crystalline form. It is concluded that ilmenite, which is scarce in the xenoliths, is probably mainly a product of the kimberlite magma. Garnetiferous rocks of the eclogite type make up only about one part in a thousand of kimberlite. They consist mainly of garnet-enstatite combinations and are not eclogite in the original sense of the term. Shand considers that it would be well to return to Beck's name *griquaite* for these rocks. The endogenous kimberlite minerals are found to be olivine (and serpentine), phlogopite, ilmenite and perovskite with a little augite in some cases. The suggestion is made that since lime is a common constituent of the rock, kimberlite may have originally contained some easily decomposed lime-mineral such as melilite.

Water Pressures on Works on Sand Foundations. A study (*Research Pub.*, 2, No. 5. Government Printing Office, Lahore. 1*s*. 6*d*.) by Dr. McKenzie Taylor and Mr. Harbans Lal Uppal deals with the relationship between pressure and stream flow. Lamb ("Hydrodynamics") has shown that lines of equal pressure are orthogonal to the stream line; from which, and the observations referred to in *Research Pub.*, Nos. 3 and 4, Nature, Sept. 15, p. 425, it follows that by tracing the stream lines and at the same time determining the pressures on a horizontal line cutting the stream lines, the equi-pressure lines can be drawn. The apparatus used by the investigators is described and the results of the pressure measurements under models tabulated for various heads. Diagrams are also given of the equi-pressure lines. Application of the foregoing lines of investigation has been made to a model of the Khanki Weir at the headworks of the Lower Chenab Canal and the results recorded in another publication (*Research Pub.*, 2, No. 6. Government Printing Office, Lahore. 1*s*. 6*d*.) in which the repairs rendered necessary to a number of bays of the dam are discussed with diagrams of equi-pressure lines and photographs of pressure observations.

Vibration of Beams and the Whirling of Shafts. The problems of vibrating beams and whirling shafts are of considerable practical importance in engineering.

Assuming that the materials are perfectly elastic, mathematical solutions have been obtained which are of use to the engineer. Unfortunately the complete theory is very complicated. In a paper in the *Scientific Proceedings of the Royal Dublin Society* (Aug. 1934), Dr. H. H. Jeffcott shows how approximate solutions can be obtained by simple graphical or tabular methods. In a previous paper he gave algebraic solutions of particular cases. His new method leads to solutions sufficiently exact for all practical purposes. It has to be remembered that there is always some uncertainty about the mechanical data and so it is unnecessary to aim at high accuracy in getting numerical values. Approximate solutions are all that are needed. The methods given are of general applicability and can be applied to the solution of problems involving moving and pulsating forces or hammer blows.

Fine Structure of X-Ray Absorption Edges. A theory of the fine structure of X-ray absorption edges has been given by R. de L. Kronig. The electron leaving the atom suffers scattering by the neighbouring atoms, and in the case of an atom embedded in a crystal lattice this scattering only allows the electron to escape when its energy has one of several discrete values. A similar effect occurs when the atom under consideration resides in a gas molecule, the de Broglie waves scattered by the neighbouring atoms interfering with the original wave in a manner which depends on the wave-length and therefore on the velocity of the issuing electrons. In *Physica* of July (1, No. 9), D. R. Hartree, R. de L. Kronig and H. Petersen give a calculation for the fine structure of the Ge K-edge in $GeCl_4$ and D. Coster and G. H. Clamer describe an experimental investigation which agrees with the theory. The $GeCl_4$ molecule is well adapted for investigation since the Ge K-band lies in a region of the spectrum suited to experimental investigation, while the molecule has a symmetrical tetrahedral structure which greatly simplifies the calculations. Further, the Cl atoms scatter quite strongly and give a well-marked structure to the edge. The atomic field for neutral chlorine is required since $GeCl_4$ is a non-ionic molecule. It was calculated by the self-consistent field method. The wave equation was then set up and solved for an electron in this field (the four Cl atoms merely involve multiplication by 4) and the effect on the fine structure finally calculated. The deformation of the Cl structures by the intermolecular forces and exchange between the escaping photoelectrons and the other electrons were neglected. The positions, and the order of magnitude of the intensities of the fine structure components, are correctly predicted. It appears that in some cases this method may be used to throw light on molecular constitutions and in particular to decide between homopolar and ionic binding.

Magnetic Moment of the Proton and the Deuton. I. I. Rabi, J. M. B. Kellogg and J. R. Zacharias (*Phys. Rev.*, Aug. 1) have used a new molecular-beam method for obtaining a value for the magnetic moment of the H^1 and H^2 nuclei. The method depends on using a magnetic field which is highly inhomogeneous, but not strong enough completely to decouple the nuclear and electron spin. The magnetic moment of the nucleus does not contribute directly to the total moment of the atom, but it influences the average orientation of the electron moment with respect to the field. From the inhomogeneous field experiment it is possible to measure the magnetic moments of the magnetic states, and the nuclear moment is deduced in the same way as in the method depending on the hyperfine structure of spectral lines. In the experiments a beam of neutral atoms was derived from a Wood's discharge tube and deflected by a field produced by a heavy current in a pair of wires. No iron is used in the magnetic system. The value obtained for the moment of the proton is $3\cdot25\pm10$ per cent and for that of the deuton $0\cdot77\pm0\cdot2$. The former value agrees moderately well with the value obtained by Stern, Estermann and Frisch, using a different method depending on the deflection of hydrogen molecules in a strong inhomogeneous field. (See NATURE, 133, 911, June 16, 1934.)

Isotopes. 55 pages and 4 plates in the issues of the *Physikalische Zeitschrift* of July 15 and August 1 are devoted to a review of the present position of our knowledge of isotopes, by Dr. J. Mattauch of the University of Vienna. The various methods which have been developed for the investigation of isotopes based on the use of positive rays or on the displacements of line or band spectra are described in turn, and the final table of results covers nearly five pages. For each substance, the table gives the atomic number, the integral atomic weight, the method or methods used, the relative amount of each isotope present, and in many cases its packing fraction and its atomic weight to five significant figures, with the possible limits of error. Nearly 260 references are given.

Paschen Series in Stellar Spectra. A comparison of the Paschen and Balmer series of hydrogen in some stellar spectra made at Mount Wilson Observatory has been described by Merrill and Wilson (*Astrophys. J.*, July). The Paschen series is, of course, in the infra-red region of the spectrum, and its investigation in stellar spectra has been made possible by recent improvements in the infra-red sensitivity of photographic plates. Investigation of the infra-red regions in stellar spectra is considerably hampered by the presence of bands in the spectrum of the earth's atmosphere, but there happens to be a gap through which the Paschen series from $m = 24$ at 8333 A. to $m = 11$ at 8862 A. can be seen. The general behaviour of the Paschen series in the spectral sequence is, as was to be expected, roughly the same as that of the Balmer series. The Paschen series is conspicuous in the c stars β Orionis $cB8$ and α Cygni $cA2$. Comparison of the two series should yield a direct value of the surface temperature of the star, from the relative number of hydrogen atoms in the second and third states. The authors have carried out photometric measurements of the intensities of the lines in the two series, and deduce stellar surface temperatures in this way, but the result is not completely satisfactory because the different members of each series do not give the same number of atoms in the quantum state common to all the members of the series, as simple theory predicts that they should do. One is reminded of the highly anomalous intensities exhibited by the first few members of the Balmer series in the solar spectrum. The value obtained from the Balmer lines for the number of atoms in the second state increases with increase of m, coming to a maximum at about $m = 15$ in most stars—well on in the series. The authors find 9,000° for β Orionis and 8,800° for α Cygni for the effective temperature ($2^{1/4} \times T_0$) in both cases.

Problems of Freshwater Biology

A SURVEY of certain aspects of freshwater biology was arranged by Sections D (Zoology) and K (Botany) of the British Association, under the chairmanship of Dr. E. S. Russell, at Aberdeen on September 10. One of the major problems considered was that of the production of algæ in natural waters. These organisms serve as producers of organic materials, and hence their number is a measure of the amount of sub-aqueous life possible. They also serve as indicators of the quality of the water, a field which requires further investigation. On the other hand, their presence may lead to tastes or odours undesirable from a water consumer's point of view and, in waterworks, they may, if abundant, cause considerable expense in filtration.

Prof. F. E. Fritsch, in opening the symposium, pointed out that very little is really known about the way in which the phytoplankton of lakes and reservoirs pass through their periods of dormancy, or of the manner in which they are able to develop and to become abundant in the free floating condition. Few species are known to produce resting spores, and motile developmental stages appear to be infrequent. Prof. Fritsch summarised the existing information.

Dr. W. H. Pearsall then dealt with the relation between the abundance or scarcity of algæ and the chemical composition of the dissolved substances in the waters. He developed the view that the proportions between available nutritive substances, such as those yielding carbon, nitrogen and phosphorus, are of great importance both in determining algal abundance and also in deciding which species become predominant.

The examples quoted in these earlier papers suggest that freshwater biologists will soon require a further detailed knowledge both of the water movements in lakes and also of the manner in which nutritive substances are produced by the oxidation of organic matter in natural waters. Mr. J. T. Saunders approached one of these problems, that of water movements in lakes, by a rather novel method. Using a form of thermocouple, he has found it possible to measure water temperatures so rapidly as to throw considerable light on water movements. Among other details of interest was the conclusion that the oily patches common on the wind-swept surfaces of lakes are of lower temperature than the surrounding surface waters, and represent the upwelling of the return currents which balance the surface wind-drift.

Dr. B. Barnes approached the second problem, that of the sub-aqueous decay of organic matter, in summarising the available information about the biology of the aquatic fungi. Apparently these little-known organisms occur chiefly in shallow water and during periods of low temperature. Many of them are parasites and all appear to be of infrequent occurrence. Hence they may play only a small part in sub-aqueous organic decay, which is presumably to be attributed chiefly to bacteria.

Another major problem of aquatic biology, that of the food chains by which the larger animals are linked with the smaller organisms, was dealt with by Mr. F. K. Pentelow, who summarised extensive observations on the foods of fishes, particularly trout. His conclusion that trout have catholic tastes and are, on occasion, practically omnivorous, received abundant confirmation in the subsequent discussion.

Building Trades Exhibition

IT is not so many years ago that building was one of the most traditional of our industries, its methods and materials having been handed down from generation to generation and being in many instances peculiar to their special localities. That this state of affairs no longer exists, and that the very varied assortment of trades now occupied in building have indeed 'put their house in order', is made evident by even the briefest of tours of the Building Trades Exhibition, which is being held at Olympia on September 12–26.

The immediate impression conveyed by the Exhibition is undoubtedly that of the high quality and specialised nature of the products exhibited. In some instances, as, for example, with electrical apparatus, it is fairly obvious that the products are the direct outcome of intensive research. In others, notably in the use of that apparently unsuitable material, aluminium foil, as a thermal insulator, established scientific principles have been successfully interpreted in a practical form.

Even with the older materials, such as bricks, paints and plasters, indications of scientific development are to be seen on every side. To appreciate this, it is only necessary to examine a stand such as that of Imperial Chemical Industries Ltd., where an extensive range of plasters and cement products is being shown, each suited to a special purpose and supplied ready mixed so that the minimum of time and skill is needed for application. The fact is also well illustrated by the number of materials which are now produced to detailed specifications.

The focus of scientific interest in the Exhibition lies, of course, in the comprehensive exhibit arranged by the Department of Scientific and Industrial Research, illustrating the work of the Building Research Station at Watford and of the Forest Products Research Laboratory at Princes Risborough. This ranges from fundamental work on the constitution of cements, to such varied problems as the behaviour of structural steelwork and reinforced concrete, the stability of paints on plastered surfaces, the designing of buildings to receive maximum sunshine, and the control of insect and fungoid pests in timber.

Perhaps the most interesting section of this exhibit is that dealing with the investigation of the causes of fracture of reinforced concrete piles during driving. Special piezo-electric gauges are embedded in the pile and are connected as required to a cathode ray oscillograph to give records of the impulsive and vibrational stresses caused by the blow. It has been found that tensile stresses of a dangerous order may be developed either at the head or the toe of the pile, according to the nature of the blow and the type of ground into which the pile is being driven. The

recording apparatus is shown working in conjunction with a model pile-driver.

Another interesting series of exhibits on this stand is concerned with the 'creep' of concrete. When subjected to sufficiently high tensile or compressional stresses, concrete has the property of flowing slowly to relieve the stress, a feature which in some circumstances might have unfortunate consequences. Methods of examining this property are shown, together with numerous experimental data.

In the Heating Section of the stand of the Department of Scientific and Industrial Research, special mention may be made of the instruments developed for the measurement of the degree of comfort of a room in terms of 'equivalent temperature'. The 'eupatheoscope' is a research instrument designed to react to its environment in much the same way as a human being. Simple portable instruments, on the principle of the kata-thermometer and suitable for the general use of the heating and ventilating engineer, are also exhibited.

Finally, attention may be directed to the very topical exhibit of the 'housing centre', dealing with London's slum problem and entitled "New Homes for Old". Much of the material exhibited—for example, the reconstructed slum—has mainly a humanitarian appeal, but those portions concerned with the town-planning aspect of the problem, particularly that due to the "Mars" group of architects, are of a notably scientific character. It is to be hoped that the analytical treatment of the slum problem, which is here exemplified in the case of Bethnal Green, will lead to a better appreciation of its complexity and to its more rapid solution.

One of the most interesting suggestions for re-planning is that of the British Steelwork Association, that buildings in the centre of London could with advantage be made more nearly uniform in height, but that, on selected island sites, greater height than the standard should be allowed, provided that ground area was given up for the widening of the surrounding streets. The suggestion is supported by an attractive model.

H. E. B.

Chemistry of Antigens and Antibodies*

DR. J. R. MARRACK prefaces his review of the chemistry of antigens and antibodies and the nature of the reaction between them by a short account of certain aspects of physical chemistry, including recent developments of our knowledge of the shapes and sizes of molecules and the application of this knowledge to proteins, on account of their importance in connexion with immunological specificity. The part played by polar forces in the orientation of molecules, in their distortion and in the specificity of the binding of one molecule to another, as in mixed crystal formation, is described, whilst an account of the structure and properties of different proteins, especially those of the serum, forms an excellent introduction to the main part of the review.

Antibodies appear to be proteins, and attempts to prepare them free from proteins have failed. It is generally agreed that they are precipitated with the globulin fraction of serum, whatever method of precipitation is used, but are usually not confined to any particular fraction: the antibodies in anti-pneumococcal horse (but not rabbit) sera are, however, unique in that a large proportion can constantly be separated, highly purified, in a fraction of the serum globulin, by precipitation in low salt concentration or with alcohol. The stability of antibodies to various agents is similar to that of the proteins.

The composition of the antigen-antibody complex is also in favour of the view that antibodies are proteins: for example, the precipitate of antigen and antibody contains about 90 per cent protein, even when the antigen is one of the specific carbohydrates obtained from pneumococci. An appreciable amount of globulin is taken up by the antigen from the anti-serum; the evidence suggests that this globulin is the actual antibody rather than protein adsorbed non-specifically by the antigen-antibody compound. No definite differences between antibody and normal serum globulins have been demonstrated, except the specific power of combining with antigens possessed by the former. On immunisation, a considerable new formation of globulin takes place, but only a part of this can actually react with the antigen.

Our knowledge of the nature of antigens has been increased by the work carried out in the last decade on the antigenic character of artificial azo-proteins. Various diazotised compounds can be coupled with proteins, combining presumably with the tyrosine and histidine of the protein molecules. The protein then has a new immunological character dependent on the determinant group attached to it. Thus the serum of an animal immunised to it will give a precipitate with other proteins coupled with the diazotised compound; anaphylactic shock can be produced in a guinea pig sensitised to it by injecting another protein containing the same determinant group. Both precipitation and shock can be prevented by the presence of an excess of relatively simple substances coupled with the diazotised compound, for example, an amino-acid such as tyrosine; these substances do not themselves form a precipitate with the antibody.

The specificity of the artificial antigen depends both on the group introduced and its spatial configuration. Natural protein antigens do not apparently contain such characteristic determinant groups, but only differ in the proportions and arrangement of the amino-acids of which they are built and the consequent structural differences. Immunological reactions may reveal differences between proteins which are not detected by physical or chemical methods. In addition to proteins, several polysaccharides have been isolated from different organisms, which react specifically with appropriate antisera, and their structure has been worked out sufficiently for it to be possible to relate this to their immunological behaviour.

The antigen-antibody reaction takes place in two stages: in the first, combination occurs, due to intermolecular forces, the specific character of the combination being ascribed to an appropriate distribution of polar fields on the determinant group of the antigen and on the antibody and to purely spatial considerations, since the approach of a determinant

* Medical Research Council. Special Report Series, No. 194: The Chemistry of Antigens and Antibodies. By Dr. J. R. Marrack. Pp. 135. (London: H.M. Stationery Office, 1934.) 2s. 6d. net.

group to a receptive site on the antibody may be prevented by an inert substance which gets in the way. The presence of such receptor sites on antibody molecules usually makes no difference to the protein, detectable by ordinary means: the adsorbing sites of a globulin acting as an antibody appear different from those by which it is bound when acting as an antigen. Combination of antigen and antibody is usually followed by a secondary reaction, such as precipitation, agglutination, etc. The principal constituent of antigen-antibody precipitates is protein derived from the antiserum. In the case of sensitised particulate antigens, it appears that the antibody globulin coats the particles, conferring new properties upon the complex which are very similar to those of proteins denatured, for example, by heat.

Dr. Marrack's review describes in great detail the features of the second stage of the antigen-antibody reaction and concludes with a brief discussion of the theories of the production of antibodies, including Ehrlich's side-chain theory, with which, he concludes, the developments of immunology appear to be in agreement.

The First Rhodesian Meteorite

SOUTHERN RHODESIAN GOVERNMENT'S GIFT TO THE BRITISH MUSEUM

IT was announced in the *Times* of May 25 that the first Rhodesian meteorite had been presented to the British Museum by the Government of Southern Rhodesia. The stone, weighing 48 lb. 11 oz. (22 kgm.), has since been received, and it is now on exhibition in the Central Hall of the Natural History Museum at South Kensington. It fell at 12.45 p.m. on March 7, 1934, in the Mangwendi Native Reserve, 40 miles east of Salisbury. A brilliant meteor (fireball) was seen, and three loud detonations followed by a rushing noise were heard, the detonations being heard over a radius of 50 miles. The natives said "the sun came rushing from the sky and buried itself in the earth", and they called the stone "Miminimini" meaning "something to make you gape". In its fall, it broke off the branches of a tree and made a hole 3 ft. across and 18 in. deep in stony ground. The stone itself was broken and fractured by the fall. In addition to the main mass, several small pieces were recovered, and the weight of the whole must have been about 60 lb. But this could have been only a fraction of the original weight when the stone entered the earth's atmosphere at a height of about 100 miles. Travelling with an initial velocity of 20–40 miles a second, the intense heat developed by the resistance of the air melted and dissipated material from the surface, causing a rapid diminution in size of the stone and in its velocity.

Fortunately, the stone was secured soon after its fall by the officers of the Geological Survey of Southern Rhodesia, and in the Survey Laboratories at Salisbury it has been submitted to a detailed and complete chemical and petrographical investigation. It consists mainly of stony matter with small proportions of metallic nickel-iron (3·17 per cent) and iron sulphide (troilite, 4·98 per cent). The stony portion consists of olivine, enstatite and felspar, forming a compacted mass of minute broken fragments with curious rounded grains (chondrules). Such a structure is not met with in terrestrial rocks, and its mode of origin is still an unsolved problem. Various types of meteoric stones and irons are known. The new Rhodesian stone is very similar in structure and composition to those which fell as a shower at Soko-Banja in Serbia on October 13, 1877.

While meteoric irons weighing several tons are occasionally found, meteoric stones are invariably much smaller. A large mass of more friable stony matter entering the earth's atmosphere is broken up by the air resistance and falls as a shower of smaller stones; for example, at Pultusk in Poland on January 30, 1868, there was a shower of about a hundred thousand stones. The largest single stone in the British Museum collection weighs 133½ lb.; it fell at Parnallee in Madras on February 28, 1857. The largest mass of meteoric iron in the collection is one weighing 3½ tons, which was found at Cranbourne near Melbourne in 1854.

The first meteoritic specimen to be deposited in the British Museum was a fragment of the famous Pallas iron from Siberia, which was presented in 1776 by the Imperial Academy of Sciences of St. Petersburg; and fragments of one from Argentina were presented by the Royal Society in 1778. Since then, the collection of meteorites has steadily grown, and it is now the most representative collection in the world for the study of these mysterious extraterrestrial bodies, about which much has yet to be learnt. The new Rhodesian meteorite is the fifth largest stone in the collection, to which it is a very valuable addition. Thanks are due to the Director of the Geological Survey and to the High Commissioner and the Prime Minister of Southern Rhodesia, on whose recommendation this generous donation of a unique specimen was made.

University and Educational Intelligence

THE following awards by the Institution of Naval Architects have recently been made: 1851 Exhibition Commissioners post graduate scholarship in naval architecture, 1934 (£250 per annum for two years), to Mr. Leonard Redshaw, of the University of Liverpool; Elgar scholarship in naval architecture, 1934 (£130 per annum for four years), at the University of Glasgow, to Mr. W. Ainsworth Jameson, of Messrs. William Denny and Brothers, Dumbarton; Earl of Durham prize to Mr. R. A. J. Truscott, of H.M. Dockyard, Devonport.

GERMAN educational reforms are being watched with close attention in the United States. Evidences of this appear in the pages of recent numbers of *School and Society*. In the issue of May 5 is a criticism by Prof. I. L. Kandel, Teachers' College, Colombia University, entitled: "The New German Nationalism and Education". This article alleges that the Nazi regime has set out deliberately to destroy that new education of republican Germany which was beginning to be a model for the world, and that the cult of hatred and revenge is fostered with unprecedented venom and barbarism. A week later appeared under the heading "Science and Education in Nazi Germany" an account of how the *Zeitschrift für Mathematischen und Naturwissenschaftlichen Unterricht* supports enthusiastically the purposes of the *Führer*. There is a very definite preoccupation with military preparedness on the part of several writers of recent mathematical and physical articles in the *Zeitschrift*, and biologists' contributions have emphasised *Völkerbiologie* and *Rassenkunde* as cornerstones of the new German education.

Science News a Century Ago

The Scientific Congress in France

Quoting from *Galignani's Messenger*, the *Times* of September 22, 1834, recorded that "The Scientific Congress, which has been sitting at Poitiers has closed its session. The number of its members amounted to 230". Among the questions discussed was that of the policy of employing troops on public works such as roads, while the agricultural section presented a resolution that "Salt may be beneficially used in the feeding of cattle, and in improving land, consequently the tax upon this article, which prevents it being so used, ought to be reduced". The Congress was deeply concerned with "the immorality which degrades many of the literary productions of the present day"; and it declared that "the French Academy at Rome should be suppressed being no longer of any utility". The proceedings of the Congress, it was said, have proved that the institution cannot fail to increase the welfare and happiness of society, and it was decided that the next meeting should take place at Douai in 1835.

Opening of Leeds and Selby Railway

One of the oldest sections of the London and North Eastern Railway is that from Leeds to Selby about twenty miles long. Authorised in May, 1830, it was constructed by J. U. Rastrick (1780–1856) and was opened on September 22, 1834. The first train left Leeds at 6.0 a.m. drawn by an engine of 18 horse-power named *Nelson*. "To this were attached," says the *Annual Register*, "three of the first class carriages, and six carriages of the second class, the former carrying eighteen passengers each and the latter twenty-four. The requisite preparations having been completed, a start was made; but, the rain having rendered the tram-rails so slippery that the wheels of the engine turned round at times without any sensible locomotion, only two miles were completed in a space of forty minutes. It was, therefore, thought advisable to lessen the drag of the machine as much as possible; and with that view the passengers, who occupied the six second class carriages, were stowed into five of them, and the sixth was left behind. The engine, however, proceeded at the same slow pace for some time longer, amid the jeers and laughter of the bystanders, who called to the police officers and others attendant upon her, to put their shoulders to and push her along". After stopping at Garforth viaduct "the engine shot away with her load, and did the remaining fourteen miles in forty-two minutes, being at the rate of twenty miles an hour". The whole journey occupied two hours and twelve minutes, but the return journey was made in one hour sixteen minutes. Within a year of its opening, the railway, says Sherrington, had in operation combined rail and water passenger fares between Leeds and Hull, and combined rail and road fares between Leeds and York, both through Selby.

Chemistry Lectures at the Royal Institution

In an advertisement in the *Times* of September 27, 1834, under the heading "Royal Institution of Great Britain" it was announced that "The extended and practical Course of Chymical Lectures and Demonstrations for medical and general students delivered in the Laboratory of this Institution, by Mr. Brand and Mr. Faraday, will commence on Tuesday, Oct. 7, at 9 o'clock in the morning, and will be continued on Tuesdays, Thursdays and Saturday at the same hour. Two courses are to be given during the season, which will terminate in May. For prospectus of the lectures and terms of admission application may be made to the Lecturers or to Mr. Fincher at the Royal Institution". Joseph Fincher was then the assistant secretary of the Institution. Speaking of the lectures, the physician Thomas Gordon Hake (1809–1895) in his "Memoirs of Eighty Years", published in 1892, said: "There was no medical school at St. George's, the anatomical students went to Great Windmill St., where Mr. Caesar Hawkins lectured and taught. The chemical students went to the Royal Institution in Albemarle Street, where Faraday and Brand were professors. The lectures were then delivered at eight in the morning; beautiful and perfect they were; the attendance was very thin. I am proud to remember that I imbibed my first ideas of chemistry at such a fountain head. Faraday was most charming, most unpretending; his experiments never failed, nor did those of his colleague who was a model lecturer; gentlemanly, perfect of expression, exact of execution."

Societies and Academies

Paris

Academy of Sciences, July 30 (*C.R.*, 199, 329–392). GEORGES CLAUDE: A floating Claude-Boucherot installation. D'ARSONVAL: A visit to the Tunisie. Remarks on the Claude-Boucheret installation for utilising the thermal energy of the sea. NATAN ARONSZAJN: Dirichlet's series with linearly independent exponents. EUGÈNE REMES: The effective calculation of Tchebitchef's polynomials of approximation. STEFAN BERGMANN: Integral and meromorph functions with two complex variables. GEORGES ALLARD: A general method of statistics applicable to indiscernible particles. A method for obtaining the law of statistical distribution of the molecules of a gas. This is an extension of Planck's method, and allows a closer analysis than the methods of Bose-Einstein and of Fermi-Dirac. PIERRE LEJAY: Gravity observations in Malaya, the Dutch Indies, Cambogia and Cochin China. Proof that work done with the Holweck-Lejay pendulum is in close agreement with that of Vening Meinesz. D. G. DERVICHIAN: Polymorphism in the monomolecular layers of fatty acids at the surface of water. THÉODORE KAHAN: The thermal variation of the structural demagnetising factor in nickel and cobalt. The existence of the structural demagnetising field in nickel and cobalt is confirmed by evidence of its thermal variation. The factor of this field decreases as the temperature rises. MORICE LETORT: The kinetics of the thermal decomposition of the vapour of acetaldehyde. The true order of the reaction, derived from the initial data, is 1·5: a higher value, approximately 2, results from the wall effect. WILFRIED HELLER: The coagulation of hydrophobe sols by freezing in relation with mechanical coagulation. ANDRÉ DE PASSILLÉ: Study of the dissociation of the ammonium phosphates. Data are given for the dissociation of $(NH_4)_2HPO_4$ and anhydrous $(NH_4)_3PO_4$. The study of the dissociation of the latter proves the existence of a compound $(NH_4)_5H(PO_4)_2$. RENÉ PERROTTE: Ricinic acid and 12-ketostearic acid. M. TIFFENEAU and MLLE.

B. TCHOUBAR: Transpositions in the cyclohexane series. The migratory aptitude of the migrating radical is influenced by its position in space. EDMOND URION: The oxidation of Δ-1-methylcyclohexene by selenious acid. GEORGES DUPONT and WITOLD ZACHAREWICZ: The *cis* and *trans* isomers of myrtanol. GEORGES MIGNONAC and ERWIN DITZ: The polymerisation of acetylene under the influence of heat. A yellow gaseous hydrocarbon, chlorene. The acetylene is passed in a rapid stream through a quartz tube at 750° C. and the products immediately cooled to −70° C. Two dimers of acetylene possessing the composition C_4H_4 were isolated, one of which possesses the remarkable property of being greenish yellow in the gaseous state: the name of chlorene has been given to it. JEAN HERBERT: Study of the corrosion figures of glass. The corrosion figures of glass change with the mode of attack, and have nothing in common with the figures formed when crystals are attacked by an appropriate reagent. The figures change with the concentration of the hydrofluoric acid used. G. DENIZOT: The structure of the Canary Islands considered in relation with the problem of Atlantis. The submersion of the Atlantic area was complete about the middle of the Tertiary period. Afterwards, the accumulation of volcanic products caused emergence from the sea at some points, and at times, relations with the African continent were possible. ANTONIN LANQUINE: Breaches of the Provençal chains at the borders of the northern and eastern Varois regions. R. FAILLETTAZ and R. BUREAU: The records of atmospherics at Tamanrasset (Hoggar) in the course of the Polar Year. F. RATHERY and P. M. DE TRAVERSE: Perfusion of the intestine, and glycolysis. GEORGES BOURGUIGNON: Extemporaneous variations of the chronaxy under the influence of the pain caused by chronic rheumatism. MLADEN PAIC: The rotatory dispersion of the sera of normal and syphilitic rabbits. The suggestion by Rondoni, that the rotatory power of the serum was of value in the diagnosis of syphilis could not be confirmed. MAURICE LEMOIGNE and ROBERT DESVEAUX: The origin of the nitrogen deficit in aerobic microbial cultures. The nitrogen deficiency is due to a transformation, probably an oxidation, of the ammonia arising from the decomposition of the proteins of the medium. HARRY PLOTZ: The filtrability of the tubercle bacillus. Utilising the method of electrophoresis, experiments are described proving that the tubercle bacillus can pass through the L_2 Chamberland filter. This, in the author's opinion, is the true origin of what has been called the tuberculous ultra-virus. CHARLES SANNIÉ and JEAN VERNE: Study of the toxic action of cations on the cells of various organs cultivated *in vitro*.

ROME

Royal National Academy of the Lincei, April 8. G. BRUNI and M. STRADA: New methods for separating heavy water H_2^2O from ordinary water H_2^1O. Increase of the heavy water contained in ordinary water may be effected by fractional freezing. Also, large natural carnallite crystals from Stassfurt and Beienrode yield water showing as much as 0·4 per cent of D_2O. L. CAMBI and A. CAGNASSO: Complexes of metals of the first transition series with dipyridyl and phenanthroline. M. CAMIS: Vitamin content of certain African cereals (1). Existence of the B complex. Experiments on pigeons show that vitamin B is present in *Eragrostis teff.* and *Sorghum aethiopicum* and, to a less extent, in *Pennisetum spicatum* and *Eleusine coracana*. A. PALATINI: Saint-Venant's conditions in any V_n. W. BLASCHKE and E. BOMPIANI: Enumerative reasoning on mixed textiles (*tessuti mixti*). S. BERGMANN: Certain properties of transformations by a pair of functions of two complex variables. L. SOBRERO: Application of hypercomplexes to the problems of plane elasticity (3). M. VILLA: Hyper-algebraic hyper-surfaces. B. SEGRÈ: The moduli of irregular algebraic surfaces. M. RENATA FABBRI: A particular movement of a heavy solid about a fixed point (limit of variability). G. L. ANDRISSI: The system 61 Cygni. Calculations made with the help of the measurements available indicate that the orbit of this double is hyperbolic, but the observations are too few to permit of the calculation of the orbit. A. BARONI: Alloys of lithium and cadmium. A reply is made to recent criticism by Zintl and Schneider of the results of the author's X-ray examination of these alloys. C. COLOMBI and L. PAOLAZZI: Splenic leuco-cateresis.

SYDNEY

Linnean Society of New South Wales, May 30. LILIAN FRASER: An investigation of the sooty moulds of New South Wales (2). An examination of the cultural behaviour of certain sooty mould fungi. Representatives of all types of sooty mould fungi, with controls, were grown on agar media containing a variety of different food materials. The results of these experiments are presented and discussed. H. L. JENSEN: Contributions to the microbiology of Australian soils. (1) Numbers of micro-organisms in soil, and their relation to certain external factors. Counts of bacteria, actinomycetes and fungi in fifty soils from New South Wales, and periodical counts of the same groups of micro-organisms in a soil from Sydney are recorded. The relation of the numbers of micro-organisms to humus content, soil reaction, moisture content and temperature is discussed. Humus content and moisture are shown to be the most important factors in governing the numbers of micro-organisms. H. M. R. RUPP: The habitat, character and floral structure of *Cryptanthemis Slateri* (Orchidaceæ). The supposed association of *Cryptanthemis* with the tuberous roots of *Dipodium punctatum*, R.Br. has been found to be apparent rather than real, and is not constant. It has been established that the flowers are developed and matured beneath the actual surface of the soil; but after maturity, elongation of the rhizome appears to bring the withered capitulum level with the surface, beneath accumulations of debris. The details of the floral structure were established by careful examination of fresh flowers before they suffered any ill-effects from exposure.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, 20, 251–321, May 15, 1934). MARSTON C. SARGENT: Causes of colour change in Blue-green Algæ. *Gloeocapsa montana* was cultivated in an inorganic medium in flasks standing in a glass-bottomed water-bath over various sources of light. The cycle of colour changes from dark blue-green in low intensity light to buff in high intensity light could be repeated several times with a single culture. Colour is dependent primarily on intensity of illumination; colour of incident light, temperature and composition of medium have minor

effects. W. BAADE and F. ZWICKY: (1) On super-novæ. Two types of novæ are recognised: (*a*) common novæ; (*b*) super-novæ. The former are fairly frequent in certain systems; the latter have appeared in all stellar systems at long intervals, and at maximum brightness emit nearly as much light as the whole nebula in which they originate. Tycho Brahe's nova of 1572 was probably a super-nova of the Milky Way. It is considered that the appearance of a super-nova represents the rapid transition of an ordinary star into a body of much smaller mass. (2) Cosmic rays from super-novæ. Assuming that cosmic rays are related to a sporadic process, such as the 'flare-up' of a super-nova, the intensity of such rays reaching the earth can be derived; the computed intensity is in fair agreement with that obtained by direct observation. The view is advanced that a super-nova represents the transition of an ordinary star to a neutron star, of very small radius and extremely high density, with emission of cosmic rays. EDWIN HUBBLE and MILTON L. HUMASON: The velocity-distance relation for isolated extra-galactic nebulæ. These nebulæ show the same relationship as the cluster nebulæ; hence their luminosity functions are closely similar. H. H. PLOUGH and P. T. IVES: Heat induced mutations in *Drosophila*. Exposure of larvæ for 24 hours to a temperature of 36° C. produces six times the number of mutations observed in controls, thus confirming the general results of Goldschmidt and Jollos. The number of mutations is approximately the same whether male or female parent is heated, and is doubled when both are heated. Increased tendency to produce somatic modifications is inherited, but only through the female line. CLYDE E. KEELER and W. E. CASTLE. Blood-group incompatibility in rabbit embryos and in man. Of the two agglutinins of rabbit blood, the embryos contain the same agglutinin as the mother, probably via the placenta, unless they have inherited the other agglutinin from the father. A maternal agglutinin is neutralised in an embryo containing the antagonistic agglutinogen, but the process is gradual and no blocking of the circulation occurs. A similar process probably applies in man. FRANK H. CLARK: Linkage studies of brachyury (short tail) in the house mouse. No linkage was detected with any of the fourteen other mutant genes generally recognised as being inherited independently. EDWARD W. BERRY: Miocene Patagonia. Preliminary studies of a collection from the valley of the Rio Pichileufu, at lat. 41° 10′ S. and long. 70° 52′ W. The plant remains are almost entirely of leaves, chiefly of dicotyledons, with a few cyprinodont fish scales and beetle elytra. The plant species confirm generally the findings from Mirhoja, lat. 44° 20′ S., long. 70° W. that the flora is a mixture of mesophytic and drier soil types, which enjoyed greater and better distributed rainfall and a more genial climate than the present flora. It is also typically American. MARSTON MORSE and EVERETT PITCHER: On certain invariants of closed extremals. G. A. MILLER: Confusions in the use of the mathematical term group. F. A. SAUNDERS, E. G. SCHNEIDER and EMILY BUCKINGHAM: The strontium II and barium II spectra. CHARLES HAIG: The effect of intensity and wave-length on the response of *Avena* to light. For short exposures (1 sec.) and white light, reaction time decreases with increasing intensity up to 100 millilamberts and then increases. The response curves are rectangular hyperbolæ and in two parts, indicating two photoreceptor processes, which are found, by using partially shielded seedlings, to be located near the tip and base of the stem respectively. The relative sensitivities of these regions to light of different colour are different. T. W. TORREY: Temperature coefficient of nerve degeneration. The results suggest that degeneration is mainly a chemical process. G. H. PARKER: The prolonged activity of momentarily stimulated nerves. Severing one or more long rays in the tail of a catfish or killifish, causes the melanophores in the radial band thus denervated to assume a state of dispersed pigment producing a marked dark band. This condition persists for a day or so to a week. A fresh cut within the dark band produces a secondary dark band; adrenalin causes all the bands to fade quickly, but as its effects wear off, the bands reappear. A 'cold block' applied to a band also causes it to fade. It is concluded that the nerves concerned remain active for periods up to days after severances from their centres. CLARENCE W. BROWN and FRANKLIN M. HENRY: The central nervous mechanism for emotional responses (2). A technique for destroying the deeper nuclear regions within the cerebrum with a minimal destruction of the intervening cortex. A radio frequency current of 3×10^6 cycles generated by a vacuum tube oscillator was used. The electrode adopted consisted of a nickel silver wire coated with bakelite (outer diameter 0·014 in.) and ground to a smooth point. By this means, regulated destruction of deep-seated nuclei can be achieved, while 'restraining' centres in the cortex are uninjured. T. C. SCHNEIRLA: Raiding and other outstanding phenomena in the behaviour of Army ants. Ants of the genus *Eciton* form temporary colony clusters or 'bivouacs' and move off ('raid') in either 'swarms' or 'columns' according to species. A colony remains 'bivouacked' in a given place (statary condition) when eggs are present and also for about three weeks while the young are in cocoons; otherwise they make a new 'bivouac' every evening (nomad condition). The raids show two peaks of activity, in the morning and afternoon respectively.

Forthcoming Events

Saturday, September 29

MICROCHEMICAL CLUB, at 11 a.m. Second meeting to be held at the University of Reading.

NATIONAL SMOKE ABATEMENT SOCIETY, September 27–29.—Sixth Annual Conference to be held at Glasgow. Dr. H. A. Des Voeux, President.

FARADAY SOCIETY, September 27–29. General discussion on "Colloidal Electrolytes", to be held at University College, London. Discussion to be introduced by Prof. H. Freundlich.

Official Publications Received

GREAT BRITAIN AND IRELAND

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No. 32: Weathering of the Stonework of the National Museum and of Government Buildings. By A. G. G. Leonard and James Ginnell. Pp. 529–532. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Scottish Society for Research in Plant-Breeding. Report by the Director of Research to the Annual General Meeting, 26th July 1934. Pp. 30. (Edinburgh.)

OTHER COUNTRIES

Report and Balance Sheet of the National Botanic Gardens of South Africa, Kirstenbosch, Newlands, Cape (and the Karoo Garden, Whitehill, near Matjesfontein), for the Year ending 31st December 1933. Pp. 27. (Kirstenbosch.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 86. Zoological Results of the Matto Grosso Expedition to Brazil in 1931. 3: Birds. By Witmer Stone and H. Radclyffe Roberts. Pp. 363–397. (Philadelphia.)

SATURDAY, SEPTEMBER 29, 1934

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The Service of Scientific News

IN any fair and reasonable consideration of the place of science in newspapers and popular magazines, or of that of the 'ephemeral' Press in carving a way for scientific advancements, it must be at once apparent that the fundamental problem can be stated in terms of the equilibrium between commercial profits and intellectual requirements. Editors indeed may be unmindful of the interesting news which science can provide daily ; reporters may be painfully ignorant of fact and careless of expression ; readers may resent uplift or get it in an indigestible form ; scientific people may criticise but do little to help ; all these things contribute to the complexities of a many-sided riddle which students of science and of public life regard as a major problem of our times, namely, how to keep developments in scientific knowledge and the community at large in effective touch for the common good. But all these things are capable of being set right in the course of time if the appropriate educational methods are adopted.

It may be asked whether all the bother about the place of popular science in the morning newspaper, or of articles of slightly greater erudition in the weekly journal, is worthy of serious attention. We have to remember that we no longer live in an age when science provides mere drawing-room magic for a gaping assembly ; we must not allow ourselves to forget that to-day it is as impossible to divorce ourselves from scientific as it is from political interests and responsibilities. Our daily lives depend at every point on the achievements of scientific research, and much of our hope for betterment in the future is closely allied to our progress in the search for knowledge, if only we can at the same time learn how to use that knowledge in the enjoyment of peace and in the service of our fellows as well as of ourselves.

There are three ways in which the ordinary man, which is the title we confer on the person who has not specialised in our own department of culture, can constantly be kept in touch with the world's progress : the Press, the 'wireless' and the cinema, each with its own peculiar technique, but with a common source of material and a common beneficiary. True, each is exploited primarily for profit and accepted largely for its entertainment value ; but one cannot doubt that among the minds in control of these three forms of enterprise, there are men and women who are very seriously aware of their responsibilities as educators and as

moulders not so much of opinion as of an intelligent basis of opinion. Of course, the public dislikes being educated, as we all dislike some things that are good for us. If the majority of us actively sought to equip ourselves as competent members of a community based for its material welfare on expanding scientific knowledge, the problem under consideration would vanish, for learning and gain would then become bedfellows. Since the majority of us do nothing of the kind, the minority are exercised to do more.

We well know that in some instances editors pay due attention to the means available for the dissemination of scientific knowledge and to the methods which scientific workers employ; in others the lack is only too painfully obvious. There is clearly room for proper co-ordination in this matter, and pronouncements by those experienced in both realms of enterprise naturally carry special weight. Sir Richard Gregory's presidential address to the Association of Special Libraries and Information Bureaux (Aslib), delivered at the annual conference at Oxford on September 21, is a noteworthy contribution. Speaking on "Science in the Public Press" he examined the treatment meted out to scientific discovery in the Press, discussed publicity from the points of view of the reader and of the worker, considered difficulties which obstruct the presentation in simple and attractive, yet substantially accurate, language of technical material, exposed faults which still mar our educational system and offered definite and considered suggestions. He echoes widely-held opinion when he asks that every daily or weekly newspaper of importance should have on its editorial or reporting staff someone capable of dealing with scientific subjects in a way which bears comparison with the presentation of news and criticism relating to finance, to art, to music or to athletics. Are the phenomena of Nature less worthy of interest than the actions of men, and are their social and economic consequences of smaller concern than our own brief antics on the stage of time? But while Sir Richard Gregory is severe in his comment on this deficiency, he recognises that "very few scientific men have the time or inclination, and indeed not many have the ability, to transform scientific material into such a form as will be understood and appreciated by the plain man". The active prosecution of some branches of science demands the use of a special vocabulary; the translation of this technical phraseology into terms in common use provides an example of the difficulties which face the lay writer and dissuade the 'expert witness' from interrupting his researches to talk about them.

Another fact which the lay mind fails to grasp is that there can be any claim to attention in a scientific narrative other than the quality of the results attained, yet workers themselves know how frequently human character and human weaknesses peep from behind a sober report of achievement. "The human interest in exploration in any field lies in the log book of the journey, the difficulties met, and how they were overcome, until the object of the expedition is attained." Since the best story is that which the explorer himself tells, it follows that scientific investigators are best qualified to offer their own knowledge to the public.

The solution offered by Sir Richard Gregory involves the establishment of an organisation to deal with scientific news in such a way as to make the best of both worlds. The suggestion is not novel; indeed science publicity has been successfully organised in the United States of America since 1921 by a non-profit-making corporation called "Science Service". The attempts made to organise a science news service in Great Britain have received little encouragement from men of science or from newspaper editors. Sir Richard proposes the creation of an agency comparable with those which handle foreign news—a body of experts who would collect material, whether news items, or considered views or 'stories', from scientific bodies and individuals, and then prepare it for circulation to the Press. Thus the ground could be systematically covered, the Press would be relieved of a duty which, in the main, it now performs badly, and the public would be kept informed of everything of interest or moment. The scheme deserves wide support; as a business undertaking, however, it needs more than goodwill, for Sir Richard Gregory considers that several years must elapse before such an enterprise could show a financial profit. The American service enjoys a substantial benefaction, and it would appear that the British public must await the coming of a public-spirited and far-sighted benefactor who is both ready and able to place popular scientific news on the same plane as other news in respect of reliability and the manner of its presentation. Until that happens, the public Press can scarcely claim to provide a symmetrical reflexion of the world's affairs.

Keith Lucas

Keith Lucas. Pp. 131+1 plate. (Cambridge: W. Heffer and Sons, Ltd., 1934.) 5*s.* net.

THE principal object of a biography is to state the achievements of its subject. The kernel of "Keith Lucas" will therefore be found between pages 98 and 108, under the heading "Keith Lucas as a Physiologist". This section of the composite work was written by Prof. E. D. Adrian; needless to say, it is happy in its author.

In Prof. Adrian's view—and no one has a better right to speak—Lucas's outstanding achievement was his demonstration that the all-or-none relation between the response and the stimulus applies to skeletal muscle; its application to medullated nerve being also implicit in his work. Adrian, with characteristic modesty, passes lightly over the reason why this discovery was so important. That reason may perhaps be brought into its true perspective. The whole fascinating framework of which Adrian himself is a master builder, in company with Forbes, Gasser, Erlanger, Matthews and a score of others—that whole edifice is erected on the foundation laid by Lucas. If the metaphor may be changed, the language of the nervous system has been read by that brilliant school of post-War physiologists, but the code in which it was written was deciphered by Lucas in the years around 1912.

Periods of stagnation exist in the history of most sciences, and electrophysiology is no exception. That department of biological inquiry had formed the work of some of the most acute thinkers of the end of the nineteenth century—Helmhotz, Bernstein, du Bois Raymond and Burdon Sanderson and Einthoven. It appeared to be a road to the understanding of the intimate processes of living matter. Then the road seemed to reach a dead end. Electrophysiology, after the death of Gotch, appeared important only in its applications, such for example as the analysis of the cardiac and other rhythms undertaken by Mines and of cardiac disorders by Mackenzie and Lewis—nor should Waller's name be forgotten in this connexion.

Now electrophysiology has returned to its own, and the recent great expansion of the subject has been rendered possible by the application of modern methods of amplification. Between the two eras of fruitfulness stood Lucas. His methods were perhaps the most advanced of which the older school—the school which as yet lacked amplifiers—was capable. With those methods he rendered possible the discoveries of the new. If I may revert to my former metaphor: Lucas discovered the cipher but the type was too small, for the most part, to be read; amplification has rendered it legible.

To return, however, to "Keith Lucas"—the book. The date of its publication is not without interest: it is now close upon eighteen years since Keith Lucas was killed. In a chapter headed "Ancestry" the late Prof. H. H. Turner speaks of Lucas's grandfather and great-grandfather, respectively, John and Edward Riddle. He says: "The esteem in which the Riddles were held is permanently recorded in the Riddle Medal at the Royal Naval School. It was established in June 1923; and it is specially significant that such an honour should be forthcoming thirty years after the death of the son and nearly forty after that of the father". A similar significance attaches to the publication of the present biography almost two decades after the death of its subject—desirable at any time, it has now become compelling. That is because every advance in electrophysiology has made the value of Lucas's researches more evident.

For the rest, the reader must read the book; it consists of a short explanatory preface by Alys Keith-Lucas and chapters on "Ancestry", "Earliest Years" by the late Prof. Turner, "At Rugby" by Col. F. C. Temple, "Undergraduate Days" and "Return to Cambridge" by the late Sir Walter Fletcher, "New Zealand" by the late George Ll. Hodgkin, "Cambridge 1914–18" by Prof. E. D. Adrian, and "War Time" by (1) G. Mervyn O'Gorman, (2) the late Prof. B. Hopkinson, (3) Major R. H. Mayo. Many who came across Lucas in his lifetime, and perhaps more who know him only by reading the published record of his works, will thank Sir Walter Fletcher, who after the War began to prepare the memoir, and Prof. Adrian, who lately brought it to fruition, for the opportunity of "getting to know about Lucas's English life, his family and his friends". J. B.

Fear and the Anthropologists

The Fear of the Dead in Primitive Religion: Lectures delivered on the William Wyse Foundation at Trinity College, Cambridge. By Sir James George Frazer. Vol. 2. Pp. x+151. (London: Macmillan and Co., Ltd., 1934.) 10*s.* 6*d.* net.

WHEN the anthropology of anthropologists comes to be written, future generations will have to explain why the first quarter of the twentieth century was so fascinated by fear, why that emotion was made to account for everything, for weddings, funerals, for religion itself. They

will doubtless notice that during the same period there was a great increase in nervous disorders in which fear is the chief element, and they may conclude that there is a link between the two phenomena.

Whatever the cause of this vogue of fear, it must certainly lie in the mind of the anthropologist, for it is not in the facts. The savage is rather less liable to phobias than we are. Of course, it is dangerous to generalise from one people to the others, for there are savages and savages ; though in the works of anthropologists they appear all very much alike, as Negro faces do to those who have merely passed them in the street. When we get to know them, we find the greatest variety. There are indeed decaying remnants hard pressed by overpowering enemies, by disease, by anxiety for the future, by despair at their own diminishing numbers : they fear much because there is much to fear. There are others, many others, with the wide open spaces and the future spread before them, free from anxiety, free from nerve-racking bustle and uncontrollable desires, who therefore take both life and death far more fearlessly than we can. Their placidity seems often callous to the over-sensitive European, but the truth is they take things as they come. Their attitude is that of the old men of the Omahas : "No one can escape death and no one should fear death, since it cannot be avoided." Death is just a break in the routine of life, and death ceremonies tend to be elaborated because men make the best of their holidays.

When therefore Sir James Frazer in a previous volume began his study of the fear of the dead, he was forced to recognise that many so-called primitives "observe customs which appear to be inconsistent with such a fear, and to indicate rather respect and affection for the souls of the departed". This fact he honestly passed on to his readers, and it was all the more to his credit as the discovery evidently ran contrary to his wishes. We had then reason to hope that in this second instalment he would investigate the conditions under which men are not afraid of the dead, as well as those under which they are ; further, that we might be shown what other things besides the dead inspire fear. Then we might discover the springs of fear. Our hope is disappointed. We had reckoned without the lure of fear. The author succumbs to it, and readily finds an excuse for his frailty. "The attitude of primitive man to the spirits of the dead is complex," it is admitted, "and full account should be taken of all these conflicting emotions and tendencies," yet it is legitimate "to single out some one particular element of the compound for special examination". Certainly a psychologist, for example, has the right to single out mind for special examination ; he may even single out phobias among mental phenomena ; but what hope has he of getting at the bottom of them if he will only observe his patients when they are afraid, and ignore the conditions that make them bold ? What earthly hope has he if he will not even consider all cases of fear, but only those prompted by open spaces ?

All the resources of Sir James's learning, all the allurements of his style, cannot save from defeat a campaign doomed at the outset by a mistake in the initial direction, which is what matters in science as in warfare. He may draw up his serried battalions of facts ; he may throw into the fray case after case of the fear of the dead ; he may even press into his service cases where there is not the slightest evidence for fear, but into which fear may be read if you have the faith. If the mourners protest that they cut down a dead man's trees because "the sight of objects which belonged to their relation makes them melancholy", they are informed they have no right to be unafraid, and so afraid they jolly well shall be. If the savage washes after a death it must be through fear. The fact that he washes after a birth, an initiation, a marriage, a royal consecration, a medical treatment, after every kind of ritual, can be excluded under the rules that were made at the outset. All is in vain. In spite of these desperate efforts the author at the end of this second engagement is further than ever from capturing a single key position. Nothing remains but to fight a rear-guard action, and to impose upon the enemy that respect which is due to the old guard fighting gamely to the end. A. M. HOCART.

New Form of Graphical Representation

Funktionentafeln : mit Formeln und Kurven (*Tables of Functions : with Formulæ and Curves*). Von Prof. Dr. Eugen Jahnke und Prof. Dr. Fritze Emde. Zweite neubearbeitete Auflage (Second revised edition). Pp. xviii+330. (Leipzig und Berlin : B. G. Teubner, 1933.) 16 gold marks.

THE second edition of this book differs from the first in many respects. The number of pages has been increased from 188 to 348, and the explanatory matter is now in both German and English. There are now nineteen sections. The first contains a table of powers and a diagram of the surface $z = x^y$, with two auxiliary diagrams for computing its ordinates. The second section contains tables and graphs for performing various

operations with complex numbers, including finding their reciprocals and square roots. Then follows a section on cubic equations, treated in a manner which will surprise the student whose knowledge of the subject has been gained only from the usual textbooks. The next two sections deal with certain equations containing trigonometrical functions.

The sixth section contains the first example of the most striking feature of the new edition, namely, the graphical representation of functions of complex variables. The function $e^{1/z}$ is shown in two ways. The upper half of p. 39 contains two sets of curves (in this case circles) superposed on squared paper, from which one can read off the modulus and amplitude of the function corresponding to the x and y of the complex variable. Below this is sketched a surface, called the 'relief'. Corresponding to any pair of values of x and y, which define a point in a horizontal plane, a vertical ordinate is drawn to represent the modulus of the function. On the surface thus formed are drawn two sets of curves, the contour lines (loci of constant modulus) and the lines of the greatest slope (loci of constant amplitude). Thus the diagram on the upper half of the page is the orthogonal projection of the contour lines and lines of greatest slope of the 'relief'. The value of this novel mode of representing a function of a complex variable is very great, and we hope that writers of textbooks will adopt it. For example, it shows at a glance the peculiarity of an essential singularity, as a point where both the modulus and amplitude are completely indeterminate. Later sections contain several other reliefs. Those of elliptic functions and of Riemann's zeta-function are particularly remarkable, and it would be interesting to have plaster models.

We have no space to describe the remaining sections in detail. The other functions tabulated include not only the well-known Bessel, Legendre, theta, and error functions, but also Planck's radiation function and source functions of the conduction of heat.

There are a few minor points which call for criticism. The list of "useful books for the computer" does not contain Barlow's Tables. The "Index of Tables of the Elementary Functions" does not contain the British Association Tables (though these are mentioned in the preface), but it does contain certain tables of which a reviewer said "the percentage of errors is about a hundred times as great as might be expected in a table on which reasonable care had been exercised".

The book as a whole is very good, and the price is not so high as that of other recent German publications. H. T. H. PIAGGIO.

Methods in Cytology

Cytological Technique. By Dr. John R. Baker. (Methuen's Monographs on Biological Subjects.) Pp. xi+131. (London: Methuen and Co., Ltd., 1933.) 3*s.* 6*d.* net.

FOR some time now a small handbook of cytological technique containing the salient facts brought out in recent editions of the "Microtomist's Vademecum" has been a possibility. In some ways, Dr. Baker's book fills this gap. What really seems to be wanted, however, is a little book on cytological technique with good illustrations of tissues and cells prepared by a skilled cytologist, with, side by side, illustrations of the same types of tissues and cells in which the method has worked unsuccessfully. It is very common nowadays to find that published papers have been written by persons who have not mastered such techniques as Da Fano or Weigl.

Dr. Baker has attempted to give the student some insight into the reactions of the various commoner fixing substances, used singly, which they never are. The student is encouraged to use such a tissue as the liver, pieces being punched out with a cork borer. In Dr. S. G. Scott's time, about twenty-five years ago at Oxford, the senior histology students were put to this sort of work, only the liver was cut into squares with a scalpel—a much better way. It is nevertheless a depressing fact that one could be good at stabbing a liver with a cork borer, and bad at making cytological preparations.

The only way to get a correct impression of a man's cytological technique is to see some of his preparations, and the reviewer has not had the pleasure of seeing any of Dr. John Baker's slides, and so does not know just how seriously to take some of Dr. Baker's opinions on technique. Dr. Baker is not always impressed, so we gather, by Gustav Mann, Bolles Lee, Champy, Altmann, Benda and the reviewer. Some of Dr. Baker's criticisms, captious as they are, may be justifiable, but why put them in a junior student's textbook? Dr. Baker finds Champy's fluid inferior to Altmann's (which he dilutes), and he looks upon Champy's fluid as a modified Altmann. The reviewer rather regards it as a modified Flemming, the addition of the bichromate of potassium producing a more robust stain with hæmatoxylin or acid fuchsin. Champy's fluid is not likely to be ousted by any form of Altmann's mixture. Benda's intricate method, so little used nowadays, but such a wonderful one when it can be got to work, presents no difficulty to Dr. Baker.

While Dr. Baker has added nothing to current fixing and staining technique, he has written a readable and useful book which the reviewer recommends. J. BRONTË GATENBY.

Structure of Matter

Handbuch der Radiologie. Herausgegeben von Prof. Dr. Erich Marx. Band 6: *Quantenmechanik der Materie und Strahlung.* Zweite Auflage der "Theorien der Radiologie". Teil 1: *Atome und Elektronen.* Pp. x+466. 43 gold marks. Teil 2: *Moleküle.* Pp. viii+604. 56 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933, 1934.)

THE opening chapter of this work is a masterly and highly condensed statement of corpuscular and wave-theory by M. von Laue (Berlin). After dealing with de Broglie waves and leading on to the Schrödinger equation, he gives a short account of the mathematical theorems necessary for a more elaborate treatment of wave-mechanics and Dirac's theory of the electron. The reading of this section of the book requires considerable mathematical skill but has the advantage that it covers all the essentials in a minimum of space.

The second chapter gives a fairly complete survey of experimental researches and theories concerning excitation and ionisation of atoms and is by Hanle and Larché (Jena), who have themselves published valuable papers on the subject. The section dealing with the excitation and ionisation of atoms in solid bodies is particularly welcome as no other account of the same scope is available. It is regrettable that the authors follow Döpel on p. 194 in using the term 'neutron' for a neutral hydrogen atom, the more so as in the fourth chapter (on nuclear structure and quantum mechanics) the term is used in its accepted modern sense as introduced by Chadwick.

F. Bloch discusses in Chap. iii the electron theory of metals in considerable detail. He shows that it enables us to understand quantitatively or qualitatively the most important properties of metals, but he also points out its inability to deal with the interaction of the conduction electrons, which is probably the reason why the phenomenon of supra-conductivity has not yet been explained.

By far the largest chapter of the book is the last, which deals with nuclear structure and quantum mechanics. Prof. Beck of Prague is the author. He points out that—thanks largely to the work done at the Cavendish Laboratory—there is now an abundance of empirical material available, which it has not yet been possible to include in a single theory. It is true that new relationships have been discovered by applying quantum-mechanical methods to various individual problems, and to explain some of the experimental phenomena, but other questions have arisen in nuclear physics which seem to make it necessary once again to undertake a radical revision of our fundamental physical concepts. A complete theoretical treatment does not merely entail the discovery of a model, but must also have as its objective the formulation of physical laws themselves. The author's account embodies the results of very recent work, as is seen from the table on p. 386 where twenty-two nuclear reactions are enumerated; they include the production of neutrons and also their use for disintegrating nitrogen. There are two other tables, one dealing with the uranium-radium series of elements and the other giving a list of the elements with their atomic members, isotopes, relative amounts of associated isotopes, mass, mass defect (in electron-volts), nuclear spin, magnetic moment. The latter table occupies eight pages. The bearing of nuclear properties on optical spectra is discussed, also hyperfine structure, passage of penetrating radiation through matter, theory of radioactive processes and certain difficulties in Dirac's theory.

In the second part of vol. 6, the high standard of the first part is maintained throughout. We have here five sub-sections dealing with molecules in their various aspects. The first section is by R. de L. Kronig (Groningen), who gives a quantum-mechanical treatment of band spectra and molecular structure. Two particularly interesting paragraphs are devoted to predissociation, and change of intensity and nuclear moment of momentum. P. Debye (Leipzig) and H. Sack (Brussels) contribute an important section on the theory of the electrical properties of molecules. A brief résumé is given of the older work, the formulæ of Clausius-Mosotti and Lorenz-Lorentz being successively derived. The theory of molecular dipoles and its application to chemical structure is discussed, and the section closes with a mathematical treatment of the electrical asymmetry of molecules.

A. Placzek (Copenhagen) accomplishes very successfully the difficult task of giving in some fifty pages a comprehensive account of the quantum-mechanical theory of Rayleigh scattering and the Raman effect. The molecular theory of magnetism is worked out in detail by F. Bloch (Rome) in the fourth section, and the last section on quantum theory and homopolar chemical bonds is contributed by W. Heitler (Bristol).

It is superfluous to attempt to express adequately the great merit of this volume of Marx's series of handbooks. The names of the various authors are a sufficient guarantee of the high standard attained. It is to be noted that the various sections of either of these parts of vol. 6 may be purchased separately (there are nine sections in all) at a price which for all the sections taken together works out at almost the same as that of the complete set. No physics library or research institute can afford to be without these volumes.

H. L. B.

Short Reviews

Vergleichende Länderkunde. Von Alfred Hettner. Band 1: *Die Erde, Land und Meer, Bau und Hauptformen des Festlandes.* Pp. viii+221. 7 gold marks. Band 2: *Die Landoberfläche.* Pp. viii+172. 6.40 gold marks. (Leipzig und Berlin: B. G. Teubner, 1933, 1934.)

THE fundamental conception upon which this work is based is that the individuality of a geographical region extends throughout the entire realm of Nature, and is not limited to any single factor, climatic, geological, biological, human or political. It follows, therefore, that the treatment of every branch of the science of geography should be comparative rather than purely descriptive. This method has been adopted by the author and in this treatise he aims at a synthesis of the relationship between cause and effect throughout the geographical habitat.

A knowledge of the earth's origin, internal structure, etc., is a necessary basis for a complete understanding of its surface forms. Part I of the first volume is, therefore, devoted to the cosmical and related aspects of the earth, and concludes with a useful and comprehensive appendix dealing with mathematical geography and cartography. The second half of the volume gives a clear account of the general form of the earth's surface, the distribution of land and sea, the sub-divisions of the continental areas, the materials of the crust and the internal forces such as earthquakes, volcanoes and earth movements which influence the surface topography. This section concludes with a simple account of the structure of the different continents.

Vol. 2 is devoted to comparative physiography and commences with a general account of the surface agents of denudation. This is followed by a detailed discussion of the main geographical cycles under varying tectonic, structural and climatic conditions. Throughout this discussion, the comparative aspect is well preserved.

The book is profusely illustrated with maps and photographs and, although the author states that it was not written as a textbook, it is in effect an excellent and moderately advanced textbook of comparative physical geography.

Dynamics of Earthquake Resistant Structures. By Jacob J. Creskoff. Pp. xi+127. (New York and London: McGraw-Hill Book Co., Inc., 1934.) 15*s*. net.

ALTHOUGH it might appear that such a subject has little direct application in Great Britain, it will be found that the problem treated in this work is one of vibration in structures and, as such, is worthy of close consideration. The object of the book is to provide design procedure and data for buildings which are to be erected on ground subjected to earthquake activity. The opening chapters deal with seismography, illustrating the earthquake history of the United States and presenting a résumé of seismography in general.

After a short account of the simple beam theory and the empirical formulæ adopted for the reinforced beam, the fundamental principles of free and forced vibration of beams are considered, followed by an examination of the resulting moments and stresses due to these dynamic effects. The application of these principles to buildings is introduced by short notes on the geology of building sites. The end conditions, as determined by the character of the foundations, are also discussed, and the appropriate coefficients for use in the frequency formula suggested. Finally, the complete design procedure is presented in an ordered arrangement so that the reader may be guided carefully through each phase of the calculations.

Two examples of aseismic design are given, one for a building 540 ft. in height, the other for one of 144 ft. The work of computation is given in detail and is easy to follow. The book contains numerous and valuable references, and is written in the brief manner of a handbook, so that it is suitable for direct application to design.

Elements of Hydraulic Power Generation. By Arthur M. Greene, Jr. Pp. iii+58. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 6*s*. net.

THIS slender manual of almost breast pocket size sets out very briefly the elementary principles and calculations essential to the design and construction of hydraulic power plant. Stated to be intended to supplement in the hydraulic power field the author's "Elements of Power Generation", it affords in admirably compact form an insight into the nature and capabilities of the apparatus used in hydraulic power development, and accordingly it should be particularly useful to the student, draughtsman and young engineer. Detail drawings and photographic illustrations are given of various modern installations, such as the Conowingo, Niagara Falls and other notable developments. An unusual feature of the book is that it is produced as if typewritten, with the technical terms and important matter underlined instead of being italicised. The illustrations are clear and the type legible.

Line Coordinate Charts for Vapor Pressure-Temperature Data. Prepared by Frank E. E. Germann and Odon S. Knight. *Boiling Points of Ring Compounds.* 36 in. × 12 in. *Boiling Points for Chain Compounds.* 36 in. × 12 in. (Boulder, Colorado: Prof. Frank E. E. Germann, Department of Chemistry, University of Colorado, 1933.) 1 dollar each.

THESE charts, the origin and use of which are fully explained in *Industrial and Engineering Chemistry* (**26**, 467; 1934), enable the boiling points of a large number of compounds at varying atmospheric pressures to be read off very simply and with sufficient accuracy for all practical purposes. The idea is ingenious and the charts are well executed. They should prove very useful in laboratories.

Transport and Storage of Food

THE annual report of the Food Investigation Board* reviews the work carried out in 1933, which was initiated and inspired by Sir William Bate Hardy, whose death on January 23, 1934, robbed the Board of its Director of Food Investigation at a time when the results of his researches were being more and more applied on the commercial scale in the preservation of foodstuffs. The report refers also to the death of Sir Walter Morley Fletcher and to the resignation through ill-health of Prof. J. J. R. Macleod; the tenure of Sir Joseph G. Broodbank as chairman of the Board had been extended, and Sir J. Alfred Ewing had been re-appointed, and Prof. T. P. Hilditch appointed, members of the Board.

As in previous years, the report is divided into sections dealing respectively with the work carried out at the Low Temperature Research Station, the Torry Research Station and the Ditton Laboratory, as well as at the National Physical Laboratory and the Imperial College of Science and Technology. The researches in progress are briefly described by the actual workers concerned. Some have already been published in detail in the scientific Press, others have not yet been completed. In notices in NATURE of earlier reports of the Board, some of the results obtained by the different research workers have been described in considerable detail. On the present occasion, it appears that it might be more profitable to consider some of the broader aspects of the Board's work, and to review the progress made during the past seventeen years, during which Sir William Hardy had been first chairman of the Board and later director of food investigation, in which position he has been succeeded by the Acting Director, Mr. E. Barnard.

At the recent meeting of the British Association in Aberdeen, Sir Frank Smith delivered the Hardy Memorial Lecture on September 8, taking as his subject the transport and storage of food and the influence of Sir William Hardy's work upon food supplies, especially in Great Britain. In this connexion, reference may be made to the aims of the Food Investigation Board, with its annual expenditure of about £45,000, which are not always fully understood. The Board's object is, and always has been, the improvement of the nation's food-supply, of which a considerable part is derived from overseas. However, while the source of a particular foodstuff is not the primary consideration, preference is accorded first to home-grown produce, then to that of the Dominions and other oversea parts of the Empire and finally to foreign produce. It follows that much of the work which finds a place in the Board's programme is intended to find its application abroad. Great importance is attached to increasing our knowledge of the fundamental properties of foodstuffs, since it is from such work that large advances in the technique of storing and transporting food must be looked for. The principle of gas-storage, for example, was established as the result of a purely scientific inquiry into the phenomenon of dormancy in seeds. The results of such work are, of course, of universal application; moreover, it is impossible to predict in what direction they will find application. For example, the results of work on the oxidative changes in the fat of beef and mutton have been applied in the storage of butter, of bacon and of vegetable oils. Much fundamental work required for the needs of our own people cannot be carried out here because the experimental material is unobtainable, so that it is the Board's task to promote this where it can best be done. An obvious example is the physiology of tropical and semi-tropical fruits.

The principal foodstuffs on which researches have been carried out are meat, bacon, fish and fruit and vegetables. Seventy years ago, no one in Great Britain had tasted lamb from New Zealand, since it could not be transported and remain fit for food. In 1932, Great Britain imported 7 million pounds' worth of lamb from New Zealand, and this was only about a tenth of the total meat imports. The possibility of importing meat in an edible condition is due to the use of cold as preserving agent. But the satisfactory use of refrigeration depends on a number of factors apart from the maintenance of the requisite degree of cold. Thus cleanliness in handling the carcases is of the utmost importance. The time of hanging before and after refrigeration must also be considered. Hence it is necessary to know exactly what happens in muscle (meat) from the time the animal is killed to the time the meat reaches the consumer, the behaviour of the constituents of the muscle during autolysis, and during freezing and thawing, and the effect of the growth of micro-organisms upon them, before it is possible to specify the correct conditions of storage and transport, with which the refrigerating engineer must comply. When Sir William Hardy started his work on food preservation, he found that the science of refrigeration had grown at a rapid rate, but on the biological side advance had been slow. He initiated a large expansion in the biological research on foodstuffs, the results of which have already borne fruit in commercial practice.

* Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1933. Pp. ix+248. (London: H.M. Stationery Office, 1934.) 4s. net.

One of the disadvantages of freezing, especially of beef, is the occurrence of drip when the meat is thawed, due to the formation of ice crystals between the muscle fibres which break them up, and so prevent the reabsorption of the water when the meat is thawed. With very quick freezing, the ice is formed within the fibres and the size of the crystals is diminished, with the result that the drip is less when the meat is thawed. However, the requisite rate of freezing is so high that it is unattainable in pieces of meat thicker than about $2\frac{1}{2}$ in. Once frozen, moreover, the meat must be kept at a lower and therefore more expensive level of temperature than usual, namely, not higher than $-20°$ C. For short periods of storage, chilling, that is, storage at $-1°$ C., is a satisfactory method of preserving meat, provided that the carcases are relatively clean bacteriologically. Beef from South America can be kept chilled for so long as five weeks, but up to the present it has not been found feasible to import chilled beef from Australia and New Zealand.

Recently, however, it was demonstrated on a semi-commercial scale at the Low Temperature Research Station that beef can be held in perfect condition in the chilled state for so long as 60–70 days in an atmosphere containing 10–20 per cent of carbon dioxide. This doubling of the life of the meat is due to inhibition of the growth of micro-organisms. The laboratory experiments have been fully verified by large-scale experiments at sea and, last year, a consignment of chilled beef in good condition reached Great Britain from New Zealand. The process of gas-storage will also probably be of value to the importers of chilled beef from South America since it seems likely that the use of carbon dioxide will enable the temperature of carriage to be slightly raised and so prevent the formation of any ice in the meat, as occurs under present conditions. It is not possible to raise the concentration of carbon dioxide above 20 per cent since higher concentrations affect the bloom of the meat. Bacon and pork, however, can be stored successfully for considerable periods in high concentrations of carbon dioxide.

Researches on the freezing and smoking of fish were described in the report for 1932 (see NATURE, 132, 736; 1933). Hitherto the resources of the Torry Research Station have been almost wholly engaged in dealing with white fish, but a start has now been made with work on the herring. Modern taste requires a mild salt-cured fish, both for the home market and also perhaps for markets overseas. It has been found that fish with the authentic rich cured flavour can be produced with a much smaller concentration of salt in it than in hard-cured fish, namely, 5 instead of 15 per cent, a level at which only some 10 per cent of the water has been extracted. These cured herrings can be cooked without previous steeping in water and are almost as soft as fresh herrings. However, these mild-cured fish will not keep unless chilled or frozen: the combination of salting and chilling appears to possess distinct commercial possibilities. It has also been found that herrings rapidly frozen in cold brine and stored at a low temperature will retain their quality for several months, and that kippers made from such herrings are barely distinguishable from those made from the freshest fish. It may be possible therefore to replace herrings imported during the late winter and spring for kippering by home-caught fish which has been brine-frozen and cold-stored earlier in the year. Here it may be mentioned that a new wing of the Torry Research Station containing seven cold chambers in which the temperature can be maintained at 0° to –23° C. was opened by Lady Smith on September 10.

Turning now to fruit, the report points out that little more can be done with imported fruit than to maintain the survey of wastage which is carried out from the Covent Garden Laboratory. The keeping quality of a fruit depends not only on the variety, but also on the stock, soil, climate, cultivation and maturity at the time of picking. The results of storage trials carried out with English varieties grown under English conditions are not applicable to varieties grown overseas under conditions which are generally different to a significant degree: it follows that each area of production must undertake such work for itself, since it cannot be done elsewhere. Most of the work on the cold-storage of fruit is of direct value to the home producer, but only of indirect value to the oversea producer; and this is even more true in the case of gas-storage.

Different varieties of English apples show a remarkable individuality in response to atmospheres containing different proportions of oxygen and carbon dioxide: only a few are suited by an atmosphere containing 10 per cent carbon dioxide with a corresponding diminution in the amount of oxygen, an atmosphere, that is, that can be obtained by regulated ventilation. Other varieties require atmospheres which raise problems in the construction of efficient gas-tight stores. In this connexion, it must be pointed out that research in biological engineering forms an important part of the work of the Food Investigation Board. In the experimental hold at the Ditton Laboratory, it has been possible to compare the efficiency of the different systems of refrigeration in current use, to evaluate such practically important biological constants as the thermal capacity of a stack of apples, the rates at which it generates heat and carbon dioxide, together with the rate

of evaporation from it, and to study also the transfer of heat from fruit to air and from air to pipes. Such work is of direct value to British shipping in the transport of foodstuffs and to home producers who may wish to store their produce.

The effect of carbon dioxide in the atmosphere is not only to depress the post-climacteric respiratory activity of the fruit, but also to delay markedly the occurrence of the climacteric itself. (The climacteric is the sudden critical change in the life of the fruit when respiratory activity is doubled, and flavour and aroma are developed, the fruit attaining maturity shortly afterwards.) Apples, bananas, peaches and pears produce a substance which stimulates the onset of the climacteric in other fruit which have not yet reached this stage, but oranges and grapes do not. With the progress of senescence of apples in air, there is a steady rise in the amount of alcohol and acetaldehyde present: in an atmosphere containing little oxygen, the accumulation of these substances is slowed, so that the life of the fruit is correspondingly extended. A relationship has been found in apples between the incidence of the climacteric, the time at which the fruit is placed in cold-storage and the occurrence of low temperature breakdown. The incidence of the latter was by far the greatest in fruit transferred to cold store at the peak of the climacteric rise in respiratory activity: unfortunately, there is no practical means as yet whereby growers can detect when their fruit enters the climacteric.

These are a few of the directions, indicated by Sir Frank Smith in his lecture at Aberdeen, in which our knowledge of the properties of foodstuffs is advancing. Such knowledge can only be of inestimable benefit to mankind, and will be for ever associated with the name of the late Sir William Hardy.

Mathematical Aspects of the Propagation of Light*

By PROF. H. M. MACDONALD, O.B.E., F.R.S.

FARADAY, like Fresnel, appears to have thought of light in terms of geometrical relations, while Maxwell sought to construct a mechanical model the motions of which will resemble those which constitute light.

Starting from Faraday's ideas, the problem of the propagation of a magnetic disturbance in free space can be approached in a direct manner. There are three vectors involved—the electric current at a point in the space, the magnetic force at the point, and the electric force at the point. The relation between the electric current and the magnetic force is given by Ampère's law, and the relation between the magnetic force and the electric force is given by Faraday's law. It should be noted that Ampère's law was established initially for steady electric currents; its extension to the case where the electric currents are varying is a result of Faraday's work. Assuming, with Faraday, that the phenomena of light and of electricity have a common origin, Fresnel's law of transversality, that the vectors which specify the disturbance are perpendicular to the direction of propagation, will hold for the propagation of an electric or a magnetic disturbance as well as for light.

These three laws are sufficient to determine the circumstances of the propagation of a magnetic disturbance in free space. It follows that for plane waves the direction of the vector j, the time rate of increase of which is the electric current, at a point coincides with the direction of the electric force E at the point, and the relation between E and j is $E = 4\pi V^2 j$, where V is the velocity of propagation of a magnetic disturbance in free space. Further, if the changes which constitute the disturbance satisfy the laws of dynamics, the potential energy per unit of volume is $\frac{1}{2} Ej$—that is, $E^2/8\pi V^2$ in electromagnetic units—and, if E_1 is the same electric force in electrostatic units, the potential energy is $E_1{}^2/8\pi$; therefore $E = VE_1$, that is, the velocity of propagation is the velocity by which an electric force expressed in electrostatic units must be multiplied to convert it into electromagnetic units; or since the product of an electric charge and the electric force on it, being a mechanical force, is the same in both systems of units, the velocity of propagation is the velocity by which an electric charge expressed in electromagnetic units must be multiplied to convert it into electrostatic units.

The Lagrangian function of the changes which belong to the propagation of an electric or magnetic disturbance in free space is the difference of a kinetic energy function and a potential energy function. The potential energy function is the function given above—the kinetic energy function depends on the electromagnetic momentum and the electric current at a point; the contribution from an element in the neighbourhood of a point cannot be expressed in terms of one vector: it depends on the electric currents throughout space. On this theory, the rate of transfer of energy from a source emitting waves of one frequency is steady, and not oscillatory as on an elastic solid theory.

Consistently with the foregoing, the effect of

* From the presidential address entitled "Theories of Light" to Section A (Mathematical and Physical Sciences) of the British Association, delivered at Aberdeen on September 7.

material media, so far as electric and magnetic phenomena are concerned, can be represented by a distribution of electric currents and of magnetic currents throughout the space occupied by the material media. These electric current and magnetic current distributions can be supposed to be due to electric charges and to magnetic particles which are in motion, and it follows from the electrodynamical equations, when these current distributions are taken account of, that the current distributions can be represented by a distribution of electric and magnetic oscillators throughout the space occupied by the material media.

Further, the magnetic field due to a distribution of electric and magnetic currents inside a closed surface at any point outside this closed surface can be expressed in terms of the components of the electric and magnetic forces tangential to the surface—that is, any distribution of electric and magnetic currents inside a closed surface produces the same magnetic field at points outside the surface as a distribution of electric and magnetic currents on the surface which is determined by the components of the magnetic and electric forces tangential to the surface at points on it, but a knowledge of the magnetic field external to a closed surface does not determine the distribution of electric and magnetic currents inside the surface which is producing the magnetic field.

When the states of motion belonging to the electric and magnetic current distributions in the material medium are steady states of motion, the material medium is in a state of relative equilibrium ; but, when an electric or magnetic disturbance is being propagated in the material medium, these steady states of motion will be disturbed and, under certain conditions, the effect of the disturbance will be to set up small oscillations about the steady states of motion. A material can be regarded as being perfectly transparent for a disturbance the only effect of which is to set up small oscillations about the steady states of motion. A condition for this is that none of the frequencies involved in the disturbance is equal to or nearly equal to any of the natural frequencies belonging to the steady states of motion.

Fresnel's relations between the amplitudes of the incident, the transmitted, and the reflected waves when a train of waves is incident on the surface separating two transparent media follow on this hypothesis, and also Fresnel's results for the propagation of waves in crystalline media. It should be noticed that on this hypothesis the electric and magnetic forces at a point in a material medium which appear in the equations are not the total electric and magnetic forces at the point, but the parts of them which are due to the disturbance.

Faraday's results for the rotation of the plane of polarisation by an imposed magnetic field when light is being propagated in a non-magnetic transparent medium follow immediately from the above hypothesis without making any additional assumptions.

Further, on the same hypothesis there will be ranges of frequencies for which a material medium is transparent, the extent of such a range will depend on the intensity of the disturbances, and between any two consecutive ranges there will be a range of frequencies for which the medium is not transparent, and the mathematical treatment of the effect of disturbances involving these frequencies will require additional hypotheses.

The theory advanced above is not a mechanical theory of light in the sense that it is possible to construct a machine the motions of which will resemble the motions involved in the propagation of light. The form of the electrokinetic energy function raises the question whether all the time rates of change involved in the propagation of a magnetic disturbance can be represented by moving points, and whether every time rate of change associated with physical phenomena involves change of position in space. It may be necessary to contemplate time rates of change which do not involve change of position in space although they satisfy the laws of dynamics. In this connexion it is of interest to observe that a result of Faraday's laws is that, when there are electric currents in a system of circuits which are in motion, the kinetic energy function does not contain terms which involve the product of an electric current and a velocity, a result which Maxwell verified experimentally.

A possible hypothesis is that physical phenomena are due to the interaction of time rates of change which satisfy the laws of dynamics, and the Lagrangian function in that case would be a homogeneous quadratic function of all the time rates of change. In actual cases only some of the changes are being observed, and the Lagrangian function which is obtained from the experimental evidence is a modified Lagrangian function where the unobserved changes are supposed to be eliminated. In certain cases, this function will be expressed as the difference of a kinetic energy and a potential energy function ; an important case is that where the unobserved changes appear in the original Lagrangian function as velocities only and there are no product terms which involve a velocity belonging to the observed and a velocity belonging to the unobserved changes. There are also cases where the modified function is of this form approximately.

Third International Locust Conference

THE investigations on the locust problem in Africa and Western Asia, organised since 1929 by the Economic Advisory Council, have developed from the beginning on an international scale, for it was considered as hopeless to study the locust problem on a narrow territorial basis. This point of view proved acceptable to other Governments, and in 1931 the First International Locust Conference was called in Rome, where representatives of three countries (Great Britain, France and Italy) accepted a common policy for the investigation of the problem, and designated the Imperial Institute of Entomology in London as the international centre for anti-locust research. The second Conference took place in 1932 in Paris, where nine countries were represented, and further arrangements were made to ensure better co-operation in the study of the problem.

Between 1932 and 1934 great progress has been made in the investigations. Vast areas in Africa and in India have been explored by special entomologists of the British, French and Indian locust research organisations. The information, which has been steadily accumulating at the Imperial Institute of Entomology, made it possible to reconstruct the course of the present locust outbreak, to disentangle the records relating to different species of locusts, and to throw much light on the problem. The Third International Conference held in London on September 11–18 had, therefore, two aims. One was to summarise the results already attained in the study of the locust problem, and another, to elaborate a programme of further work on an international scale.

The Conference was attended by the delegates and experts of thirteen countries. A noteworthy feature was the presence of practically all the specialists actually engaged in locust investigations in Africa and India, which made the discussions very fruitful and devoid of unnecessary general statements. The programme of the Conference was carefully prepared in advance, and all the papers submitted to it were printed beforehand, to avoid the waste of time involved in reading them at the Conference. Owing to these arrangements, it became possible for the Conference to work through its full programme, and to discuss in detail outstanding points of the locust problem.

The main work of the Conference was definitely based on the fact, recently established by French and British investigators, that invasions of each locust species arise from the relatively restricted, so-called outbreak centres. It is only in these centres that the transformation from the solitary phase into the gregarious phase is possible, owing to the peculiar ecological conditions. Therefore, the location of the outbreak centres for each species should constitute the basis of a comprehensive policy for the prevention of locust invasions. A number of outbreak centres have already been discovered and studied, but many more remain unknown. The Conference, therefore, paid special attention to the preparation of a list of suspected areas which must be investigated without delay by the respective Governments. The methods to be employed in the field investigations and in ecological studies in the outbreak centres have been discussed in detail, in order to standardise them and thus to make the results comparable. Particular attention was paid to the methods of studying locust populations in different habitats, to the microclimatic work and to the standardisation of biometric methods for the study of phase transformation. A similar discussion on methods of work was arranged with reference to the study of locust migrations. In this study, close co-operation must be established between entomologists and meteorologists, since the causes of the migration and its directions are most probably climatic. The Conference accordingly recommended that meteorologists should be attached to locust research organisations, and a series of suggestions was elaborated as to the types of meteorological charts most likely to be of assistance in the study of migrations.

An interesting discussion took place on the problem of fundamental research. It was pointed out that out of the field investigations there arises a number of problems in locust biology and physiology which can be solved only in well-equipped research laboratories. The Conference recommended, therefore, that Governments should provide financial assistance to university and other laboratories for research on specific problems of immediate value in locust investigations. This means that research laboratories would be offered opportunities for carrying out scientific work of general interest, provided it is done on an object of practical interest, namely, locusts. Since researches of this kind may be undertaken in various institutions, the Conference recommended that the laboratories undertaking research on locusts should communicate with the Imperial Institute of Entomology in order to avoid overlapping.

The practical problems of locust destruction did not come within the scope of the Conference, but the relatively recent method of destroying locusts by arsenical dusting from aeroplanes was discussed in some detail. The experimental results obtained so far are considered encouraging and a hope was expressed that they will be continued. At the same time, the Conference pointed out the

necessity of investigating the physiological action of poisons on locusts, in order to find possible substitutes for arsenical compounds, which have certain disadvantages.

Apart from the very fruitful discussions during the meetings, the Conference provided a unique opportunity for entomologists of various countries engaged in locust research for the personal exchange of experiences and ideas. These informal discussions occupied all the intervals between meetings, and their value for those working of necessity for years in the wilds of Africa must be very great.

The Conference demonstrated very fully that the international investigations on the locust problem are following the only possible way to its solution. The value of international co-operation in this work has now become so obvious, that it was decided to make the next Conference still more comprehensive. Accordingly, it was suggested that the Egyptian Government, which has invited the Fourth Conference to meet at Cairo in 1936, should be asked to extend the invitation to all the countries of the world suffering from locust invasions. The Fourth Conference will, therefore, mark a new period in the international attack on the locust problem. B. P. UVAROV.

Two Types of Diamond

SIR ROBERT ROBERTSON'S recently published résumé of his researches on the two types of diamond* is one of the most fascinating detective stories of modern science. It has the advantage that though the circumstances of the crime are laid bare step by step, the real criminal escapes, to be dealt with, we hope, in the sequel.

The diamond has been studied for longer than any other natural stone, and its unique character had always been taken for granted. But it has been left for Sir Robert Robertson to discover that there are two types of diamond fundamentally different in many important respects.

The original observation was that one of the diamonds he had obtained from Prof. W. T. Gordon differed from all the others by not possessing the characteristic infra-red absorption of diamond at 8 μ. Abnormalities in the absorption of diamond had been noted before, in one case by Miller so far back as 1862, but their significance had not been realised. Sir Robert, however, with his collaborators, Dr. J. J. Fox and Dr. A. E. Martin, proceeded to examine many of the physical properties of diamonds and showed that the absence of the 8 μ band was completely correlated to striking differences in a number of physical properties, while in many other properties no differences whatever could be observed.

The characteristic differences are shown in the accompanying table taken from the paper. In electron diffraction, Raman spectrum, triboluminescence, dielectric constant, refractive index, colour and specific gravity, no differences were observable. There is no doubt that structurally both types of diamond are substantially alike. The observed differences are, on one hand, those affecting reaction with radiation, that is to say, electronic; and on the other, refer to the perfection of the crystal texture, crystals of Type 2 showing by their lamination and small primary extinction of X-rays that they are of a more marked mosaic pattern than those of Type 1. The two types of difference would appear to be closely correlated, but at first sight in a most unexpected way, because from the electronic point of view crystals of Type 2 would seem more perfect than those of Type 1, while from the textural point of view the reverse would appear the case. On the whole, however, the rarer type of diamond, Type 2, seems to be the normal type, as its properties agree more closely with prediction. The 8 μ band should be an inactive one and no compound containing only carbon single valency bonds should have ultra-violet absorption higher than *c.* 2200 A. The presence of an 8 μ absorption and complete absorption at 3000 A. in Type 1 diamonds suggests strongly the effects of an abnormality similar to that produced by strain or impurity.

	Type 1.	Type 2.
Occurrence . . .	The common type	Rarer.
Form	Derivatives of cubic system	Derivatives of cubic system, but with fine parallel laminations.
Isotropy	Considerable anisotropy between crossed nicols	Nearly isotropic.
Infra-red absorption-persisting at −170° C.	At 3, 4·1, 4·8 and 8 μ	At 3, 4·1 and 4·8 μ No band at 8 μ.
Ultra-violet absorption	Not complete until 3000 λ; sequences of bands near this W.L. increasing in intensity down to − 170° C.	Not complete until 2250 λ. Faint absorption and diffuse bands near this W.L., disappearing at − 100° C.
Photo-electric conductivity . .	Small with even high voltages	Present with small voltages or none.
X-ray pattern . .	Normal. Ratio of intensity of 111/222 usually small	Normal. Ratio of intensity of 111/222 usually large.

The Type 2 diamonds in any event show properties of the greatest physical significance. The most fascinating are the photoelectric properties not shown in Type 1 owing to the heavy absorption in the activating region. Here the work of Gudden and Pohl has been confirmed and extended.

There are three types of reaction of diamonds of Type 2 to light of different wave-lengths. For

* "Two Types of Diamond." By Sir Robert Robertson, Dr. J. J. Fox and Dr. A. E. Martin. *Phil. Trans.*, A, 232, 463; 1934.

wave-lengths 2000–2400 A. (optimum 2300 A.) a normal photoelectric response is produced, but the diamond after illumination at this wave-length is left in a peculiar condition—photo-electrically activated. For a time after exposure a current is given even in the dark, but this decays with time to a constant value. Even after some days, however, much larger currents can still be obtained by illuminating with red light (optimum 5850 A.) and this current lasts as long as the light is maintained. Light of intermediate wave-length, 2400–5000 A., however, though itself producing a simple photoelectric effect on an inactivated diamond, destroys in one already activated both the dark current and the capacity for restimulation return to their ground state when disturbed by light of intermediate wave-length—deactivation.

In the general problem of the differences of the two types of diamond, Sir Robert is able to put forward a partial solution. Correlations can be found between the inactive 8 μ band and the ultra-violet band system observed in diamonds of Type 1 at low temperatures. This leads to the hypothesis that the strain to which these diamonds are subjected (shown by their strain bands between crossed nicols) allows atomic and electronic frequencies, otherwise forbidden, to be effective in absorption. How this occurs is not clear; but then we know practically nothing of the atomic conditions produced by strain in crystals.

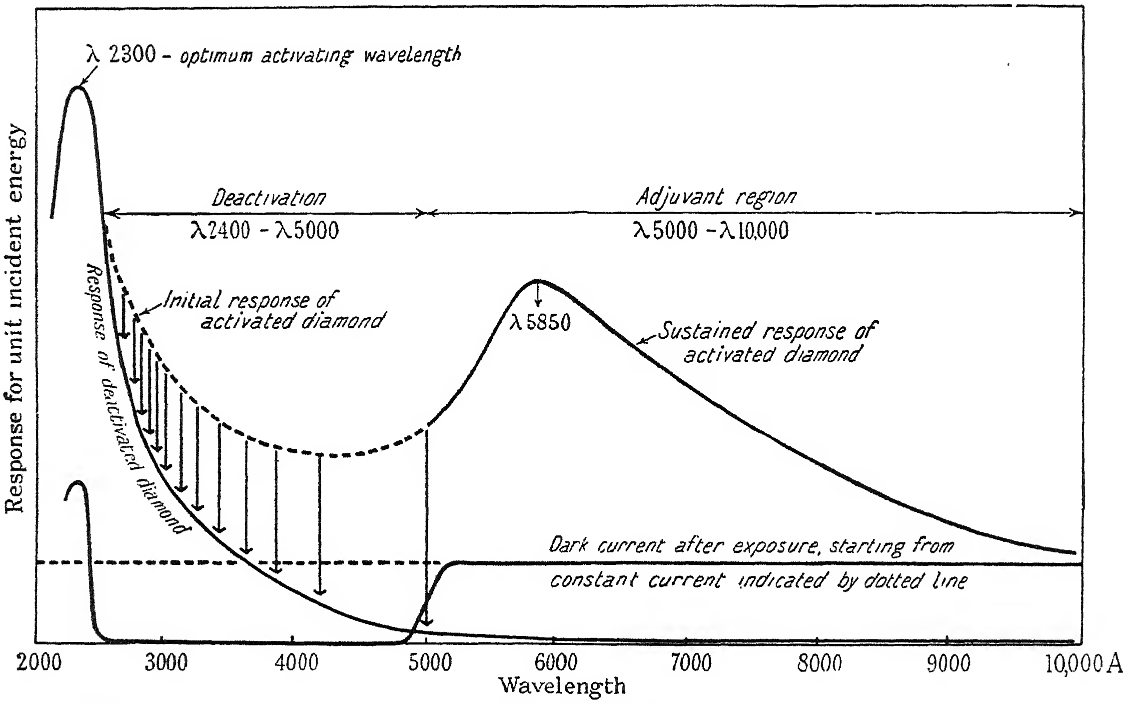

FIG. 1. Diagram showing effects of radiation on diamonds of Type 2, indicating activation, deactivation, adjuvant effect and dark current.

by red light. The general nature of the phenomenon is shown in Fig. 1 reproduced by permission of Sir Robert Robertson from the recent paper by Sir Robert and his collaborators.

A further remarkable feature of some diamonds of Type 2 is the production of currents without applied voltages. On illumination with activating light, certain parts of the diamond acquire positive, others negative, polarity and yield currents indefinitely as long as the illumination continues.

The explanation of these complex phenomena is still somewhat obscure. The activating light clearly is able to move some electrons to metastable levels where they have a certain limited mobility yielding a small dark current, and a much greater current when lifted to still higher levels by red light. They can, however, only

The differences brought out may have considerable geochemical implications and may help to throw light on the vexed question of the origin of the diamond. G. Friedel has shown that the strain bands of diamond are probably due to the fact that diamonds have passed through a transition point from another cubic form at 1855° C. (at atmospheric pressure). Now diamonds of Type 2 do not show these bands. Therefore, either they have been formed below the transition temperature, or, having passed through it, they have been able to recrystallise. This may have been assisted by the strain for which the evidence is shown by the slip planes of the Type 2 diamonds.

There is room for much further experiment and plenty already for the theorist to explain in the new chapter on crystals opened by Sir Robert Robertson.

Obituary

PROF. W. McFADDEN ORR, F.R.S.

WILLIAM McFADDEN ORR was born on May 2, 1866, and died in his sixty-eighth year on August 14, having resigned his professorship of pure and applied mathematics in University College, Dublin, and retired from active work less than a year ago. In the Ireland of Orr's youth, the examinations for the different grades of secondary education were intensely competitive, the exhibitions and prizes being valuable, and Orr, a student of the Methodist College, Belfast, although two years under age, had an unbroken and amazing series of successes. In Queen's University, Belfast, and St. John's College, Cambridge, his mathematical triumphs were repeated, and following the example of another alumnus of Queen's University, now Sir Joseph Larmor, he became Senior Wrangler in 1888; he was also given a fellowship in St. John's College, Cambridge. He became fellow of the Royal Society in 1909, and received the honorary degree of D.Sc. from Queen's University, Belfast, in 1919. In 1892 he was appointed professor of mathematics in the Royal College of Science for Ireland, and on this institution being absorbed by University College, Dublin, in 1926, he was transferred to an equal position with the title of professor of pure and applied mathematics. He retired on September 30, 1933.

Practically Orr's first published paper dealt with Bessel functions, a subject to which he returned twenty years after in a series of researches on Fourier and Bessel-Fourier expansions. In the early days of the electron theory, he was interested in giving precision to some of the mechanistic conceptions, which thirty years ago seemed the only possible points of view of this Larmor-Lorentz supplement to the Maxwell theory, and in the domain of electric waves he showed the impossibility of undamped waves in an unbounded dielectric space, whether simply connected or not. The duties of his chair turned his attention to many aspects of the work of Clausius on entropy and, in addition to some critical papers, he has left a small book, "Notes on Thermodynamics for Students", a model in its precision of formulation of principles. He will always be best known for his great work on the stability of the steady motions of a liquid (*Proc. Roy. Irish Acad.*, 1907). Improving on the results of Reynolds, his results are continually referred to in the writings of Kelvin, Rayleigh, Hopf, v. Mises and others, and are of importance in aerodynamics and fluid researches of the present day. His last published researches were important contributions to the whirling of shafts.

Everything that Orr wrote contained something of permanent value, and if the total quantity seems small, it was because of his highly developed critical faculty which he directed with the fiercest intensity against his own work. His views were esteemed and appreciated by writers like Lamb, Love and many others. In latter years, in University College, Dublin, he had a free hand to give any lectures he pleased, but, from choice, he undertook the difficult task of instilling accurate elementary ideas in the minds of science and engineering students. A firm disciplinarian and the strictest of examiners, he took a direct personal interest in all his students, who, without exception, came to like him before they parted from the College, however sternly they had been treated. He was the most modest of men about his own attainments, but was always ready to give help in applying mathematics to difficult technical and other problems, and one always had the comforting feeling that when Orr produced a result it was accurate and left little to be said on the subject.

Outside mathematics, Orr's chief interest was in cycling, and it is on record that in his Tripos year at Cambridge he carried off with great ease all the events at the University meeting of that year. This interest lasted to the end, and those in Dublin will miss the sight of his lean bearded figure going through the streets on a racing bicycle, without an overcoat, even in the coldest weather.

A. W. C.

DR. R. F. SCHARFF

BY the death on September 11 of Dr. Robert Francis Scharff, Ireland has lost one of her foremost zoologists. Born at Leeds in 1858, he studied at Edinburgh and Heidelberg, and at the Marine Laboratories of St. Andrews and Naples. He entered the Science and Art Museum in Dublin in 1887, and there he spent most of his life, holding the keepership of the Natural History Division from 1890 until 1921.

While keeping in touch with the general progress of zoology and with the museums of the Continent, Scharff devoted himself especially to the study of the Irish fauna. He produced critical lists of several groups, such as the non-marine Mollusca and the woodlice, and to his assistance and encouragement was largely due the advances made in the knowledge of the distribution of many sections of the fauna of Ireland. The fossil fauna also occupied his attention, and he devoted much time to the Mammalia of the cave deposits. The origin of the various breeds of Irish domestic animals he also investigated, as well as the Gaelic names of native species.

Scharff took a keen interest in the Dublin Zoological Gardens, being secretary of the Royal Zoological Society of Ireland from 1903 until 1910, and long a member of its Council. He was also a leading member of the Royal Irish Academy, and chairman of its Fauna and Flora Committee from its inception in 1893 until he went recently to reside in England.

Among general zoological problems, Scharff selected for study the distribution and migration of animals, and published several books dealing with the subject —"History of the European Fauna" (1899), "European Animals" (1907), "Distribution and Origin of Life in America" (1911). He was emphatic on the difficulties offered by barriers of sea to animal migration. He was twice married, and leaves a widow, whose work on Irish sponges is well known to students of that group, and three children.

News and Views

The Cunard White Star Liner *Queen Mary*

In connexion with the launch of the Cunard White Star Atlantic Liner No. 534, named at the launch on September 26 by the Queen, S.S. *Queen Mary*, the *Times* on September 25 published a supplement containing a series of articles and illustrations dealing with Atlantic travel in general and the new vessel in particular. Though it is several times pointed out that No. 534 has been designed with the definite objective of maintaining a weekly service between Great Britain and the United States with two ships instead of three as at present, yet many will hope that her performances will be such that she will in every way prove a worthy successor to the famous *Mauretania*, and regain for Great Britain the record lost a year or two since to Germany and then to Italy. The commercial aspects of the Atlantic service, however, are touched upon by Mr. E. F. Spanner who, when speaking of high speed and sailing schedules, says that speed is expensive at all times and only such speed as is essential to provide for the maintenance of a regular weekly schedule of sailings could be regarded as justifiable. The designed speed of No. 534 is 28 knots, and to have given her a speed of 30 knots would have required 21 per cent more power.

Though but few definite figures are given as to the size, power and speed of the new vessel, it is stated that she has an overall length of 1,018 ft. and will be about 70,000 tons displacement. Before her final form was decided on, no fewer than sixteen models were tried in the experimental tank of the builders, Messrs. John Brown and Co., Ltd. The propelling machinery was the subject of inquiry by a committee appointed in 1929, of which the late Sir Charles Parsons and the late Mr. Andrew Laing were members. Five types of machinery were considered and the final decision was for water-tube boilers and geared turbines. There will thus be 24 oil-fired water-tube boilers generating steam at 400 lb. per sq. in., superheated to 700° F., with four sets of turbines with single reduction gear driving four shafts. In addition to these boilers, however, there will be three cylindrical boilers in a separate stokehold generating steam at 250 lb. per sq. in. for what is referred to as the "hotel services". The electric generating plant will include seven 1,300 kw. turbogenerators, generating direct current at 220 volts. By no means the least interesting of the many articles in the *Times* supplement are those dealing with the chain cables and the launching arrangements. For the cables, steel with an ultimate strength of 31–35 tons per sq. in. is being used. Every other link in the cables is a drop forging, and these are connected by links made in halves and then electrically welded in a resistance welding machine. A sample chain cable for No. 534 required 693 tons to break it.

In an article on the preparations for launching, a description is given of the special precautions taken to prevent any damage to the hull during its passage down the ways into the water, and the layman is given some idea of the calculations necessary and the procedure followed when carrying out one of the most important and imposing of all technical operations. Needless to say, a large number of firms have contributed towards the construction and equipment of this exceptional vessel. Cunard White Star, Ltd., has lent for exhibition in the Science Museum, South Kensington, a series of photographs showing the new liner in various stages of construction.

Centenary of Schorlemmer (1834–92)

Carl Schorlemmer, the German chemist to whose memory a laboratory was erected in Manchester in 1895, was born at Darmstadt on September 30, 1834. The son of a master carpenter, he began life as an apothecary, but while an assistant in Heidelberg he was able to attend the lectures of Bunsen, and at the age of twenty-five years abandoned a business career and entered the University of Giessen, where he studied under Heinrich Will (1812–90) and Hermann Kopp (1817–92). Coming to England, he followed Wilhelm Dittmar (1833–92) as private assistant to Roscoe at Owens College, and from 1861 until 1874 was official laboratory assistant. In this situation, he began original researches in hydrocarbons, investigated the action of chlorine on the paraffins and described a valuable general method for the conversion of secondary into the corresponding primary alcohols. He was elected a fellow of the Royal Society in 1871. In 1873, he was appointed lecturer in Owens College and the following year professor of organic chemistry, the chair being the first created for this subject in England. This chair he held until his death at Manchester on June 27, 1892, having by his labours assisted Roscoe to raise the Owens College school of chemistry to the first rank. He became a naturalised British subject in 1879, but was never married. His publications have a permanent place in chemical history. In 1867 he translated Roscoe's "Elementary Chemistry" into German, and in 1871 published a manual of organic chemistry. With Roscoe, in 1877, he published the first volume of their well-known "Systematic Treatise in Chemistry". Like his countryman Kopp, Schorlemmer was much interested in the history of science, and from 1883 onwards this absorbed a great part of his time. An appreciation of him by Sir Henry Roscoe appeared in Nature of August 25, 1892, and three years later we recorded the opening of the Schorlemmer memorial laboratory which had been erected at a cost of nearly £5,000.

International Conference on Physics

The conference which will be held in London on October 1–6 promises to be as remarkable a gathering as any which has been held for many years in the metropolis. The membership of the conference has mounted to the neighbourhood of six hundred, and

delegates have been appointed to attend from almost all civilised countries. It was a fortunate chance that the dates arranged for an international conference on nuclear physics under the auspices of the Physical Society should have coincided with those of a proposed meeting in London of the International Union of Pure and Applied Physics; the fusion of the two meetings into a joint conference has resulted in a programme of absorbing interest and importance. On October 1 there are meetings of the executive committee of the International Union of Physics and of its Commission on Symbols, Units and Nomenclature (S.U.N.). On October 2–5, the sessions of the Conference will be divided between discussions on the solid state and on nuclear physics, under the presidencies of Lord Rayleigh and Prof. R. A. Millikan respectively. Opening surveys will be given by Sir William Bragg and Lord Rutherford. Meetings will take place at the Royal Institution, at the Royal Society and at Cambridge. The afternoon session of October 5, to be held at the Royal Institution, will receive the report of the S.U.N. Commission, and the meeting on October 6 at the same place will consider a communication concerning Dr. Hale's Committee on Instruments, discuss future work of the S.U.N. Commission and other business, concluding with a final meeting of the executive committee of the International Union of Physics. Titles of papers to be read will be found in our columns of "Forthcoming Events".

The programme includes several social events of interest. The Royal Society is holding a reception on Tuesday evening, and a visit will be paid to the National Physical Laboratory on Saturday afternoon. Some of the sessions on nuclear physics will, most appropriately, be held at Cambridge, and the members of the Conference visiting Cambridge are invited to lunch at Trinity College and to tea at the Cavendish Laboratory. The major portion of the scientific sessions will be devoted to papers and discussions on the solid state and on nuclear physics; but the work assigned to Friday afternoon and Saturday morning, covering as it does certain proposals concerning symbols, units and nomenclature, is of considerable importance in the present confused state of affairs, and it is greatly to be desired that the findings of the Commission will result in a much needed approach to uniformity in definitions and nomenclature. The report of the Conference will appear soon after the meeting. The more important papers will be published *in extenso*, and the report should prove a valuable record of a historic conference.

Japanese Typhoon of September 21

A typhoon that is reported in the daily Press to have passed across the south-western parts of Japan on September 21, and to have maintained its intensity there for a whole day, with winds up to about 130 miles an hour, is said to have been the most destructive tropical storm of this type that has visited Japan since 1917. In the *Times* of September 26, it is stated that the Japanese Home Office on September 25 gave the casualties as 2,305 killed, 7,839 injured and 399 missing, with a total of more than 34,576 houses totally destroyed and more than ten times that number washed away, and some 3,000 ships damaged. Information about the meteorological aspects of the typhoon is scanty. The cyclone season in that neighbourhood virtually covers the whole year, although storms are very rare in February and March. As Japan lies altogether north of latitude 30°, a typhoon that reaches that country is approaching the stage when it becomes a cyclonic depression of temperate latitudes, and having 'recurved', is generally moving north or north-east. This would account perhaps for the south-west of Japan being affected, but the north-east comparatively little. September is the month of greatest frequency of typhoons, and there is a rapid falling off in the last three months of the year. During the recent storm, trains were derailed, among which was the Tokyo-Shimonoseki express, which, with 250 passengers on board, left the rails while crossing a bridge, to be held fortunately by the parapet. There seem to have been the usual sea-waves, which penetrated far inland, and enough rain to cause serious flooding after the storm had abated. The track is said to have been from Nagasaki in the extreme south-west to the neighbourhood of Wakasa Bay, about four hundred miles to the north-east, Tokyo fortunately escaping with minor damage only.

German Association of Men of Science and Physicians

Favoured by the continued fine weather, the Gesellschaft Deutscher Naturforscher und Aerzte held its ninety-third meeting on September 16–20 in Hanover, well-known as the home of Leibniz. The attendance of some four thousand found a wide range of topics awaiting their consideration, for thirty allied societies also took part in the proceedings. Among these may be mentioned the Deutsche Chemische Gesellschaft, which contributed half a dozen papers, including one from Prof. The Svedberg on the applications of the ultra-centrifuge, and the Kolloid-Gesellschaft, which for its tenth general meeting devoted two very full days to "Röntgenoskopie und Elektronoskopie von dispersen Systemen, Fäden, Filmen und Grenzschichten". In addition to the more specialised discussions within the two main divisions of natural science and medicine, there were combined discussions and discourses of wider appeal addressed to the meeting as a whole, after the manner of the British Association. Among the last-mentioned, particular interest was aroused by Prof. W. Heisenberg's lecture, "Wandlungen der Grundlagen der exakten Naturwissenschaften in jüngster Zeit", in much the same field as that covered by Sir James Jeans's address at Aberdeen. An exhibition of apparatus, preparations and scientific books was held in the Ausstellungshalle, one of scientific films in the Tierärztliche Hochschule, and another, the travelling exhibition of the Dresden Museum of Hygiene, "Leben und Gesundheit", in the Künstlerhaus, while lighter moments were provided for by the Opera House and theatre and the usual excursions to neighbouring centres of attraction.

Radio Communication Conference at Lisbon

THE third meeting of the Comité Consultatif International des Radiocommunications (C.C.I.R.) opened at Lisbon on September 22, and will extend over a period of about two weeks. This committee was formed at the Washington Radiotelegraphic Conference in 1927 to provide a means for representatives of those administrations operating radio communication services to meet and discuss various technical matters of mutual interest, with the view of facilitating international radio communication. The previous meeting of the C.C.I.R. was held in Copenhagen in 1931, concurrently with the meeting of the Union Radio Scientifique Internationale, which has just held its plenary congress in London. The Lisbon meeting is considering a number of problems relating to broadcasting, which arose out of the Lucerne conference, in addition to questions of more general interest. The British delegates now at Lisbon include representatives of the Post Office, the British Broadcasting Corporation, the National Physical Laboratory, the Defence Services and the commercial organisations operating radio communication services in Great Britain.

Exploring the Greenland Ice-Sheet

DURING the recent summer, several attempts have been made to explore the mountainous interior of King Christian IX Land on the east coast of Greenland, between Scoresby Sound and Angmagssalik. The coast of this land, though somewhat inaccessible on account of pack-ice, has been explored by Amdrup, Mikkelsen, Watkins, Wager, Rasmussen and others, but penetration to the interior has so far proved to be baffling. Mr. Martin Lindsay has been successful in reaching this unknown area by crossing the Greenland ice-cap from the west coast. The *Times* reported his safe arrival at Angmagssalik on September 8, after a sledge journey of 1,050 miles from Rittenbäk near Jakobshavn. He was accompanied by Lieut. A. S. T. Godfrey and Mr. A. Croft, and they took with them dog teams and stores for the entire journey. Details of the work are still lacking, but the plan was to go eastward on the seventieth parallel of north latitude towards the head of Scoresby Sound and then turn south by Mount Forel to Angmagssalik. Apart from the survey work in King Christian IX Land, this expedition will have thrown new light on the ice-sheet, which it crossed in one of its wider parts. The party is returning to Aberdeen in the trawler *Jacinth*, having arrived on the coast too late to take passage in the Danish Government ship *Gertrud Rask*.

Two other attempts on the east coast of Greenland have been less successful. The *Times* reports that an Italian expedition of five, under the leadership of Count L. Bonzi, did some work on the south of Scoresby Sound, but, owing to difficulties with the pack-ice, had to abandon the project of penetrating inland from Cape Brewster. The expedition returned to Iceland on September 16. A French expedition under Dr. P. Victor failed to penetrate the belt of pack-ice off the Blosseville Coast and was landed by the *Pourquoi Pas?* at Angmagssalik in order to pass the winter in preparation for an attempt next year. Another crossing of the Greenland ice-sheet was made in August by Mr. Grierson, who flew from Angmagssalik to Godthaab in the course of his flight from England to Ottawa. Mr. J. M. Wordie's expedition to Ellesmere Island returned to Aberdeen on September 15, after charting new territory in Baffin Island. Earlier in the season, heavy pack in Melville Bay had held them on the west coast of Greenland and prevented access both to Cape York and to Ellesmere Island. There was in consequence no time to push westward to the Parry Islands and Banks Island, and any hope of making the North-West Passage was frustrated. Valuable work, however, is reported.

Effects Produced by Large Electric Currents

IN the *Electrician* of September 21, an account is given of experiments carried out in the high-voltage laboratory of the International General Electric Co. at Pittsfield, Mass., where artificial lightning at ten million volts was first produced. The engineers of the company have observed the effects produced by electric currents up to a quarter of a million amperes, which is much greater than any currents hitherto obtained. The object of the research was to find out the best way of protecting electric equipment against lightning discharges. A copper wire one tenth of an inch in diameter was completely vapourised in the few millionths of a second required for the discharge. When a piece of iron wire was used, it 'exploded', the ends of the wire that were left remaining white hot for several seconds A section of reinforced concrete placed between the electrodes was broken into bits by the current in the same way that a concrete structure is shattered when struck by natural lightning. Most of a silver-plated tea-spoon vanished in a shower of sparks, but the bowl, discoloured by heat, was left. Metallic armoured cable was in some cases destroyed, and occasionally caught fire. If the arc is confined to a small fibre tube, the tremendous pressure developed blows the tube to pieces even although it has a wall a quarter of an inch thick. In the open air, the pressure produced by the discharge shatters a pane of glass several inches away. When the current is passed through a flat copper strip, the strip is crumpled until its section is nearly round. The high ampere generator is formed by a battery of condensers suitably arranged. The discharges have to be confined within strong protecting cylinders as the explosion is very violent and makes a loud report.

Illuminating Engineering in the United States

AN address on illuminating engineering in the United States given by S. G. Hibben, the director of the Westinghouse Lamp Company, New York, has been published in the *Illuminating Engineer* of September, 1934. For underwater use, the Americans have developed special lamps. They have very strong bulbs, and both the base and the wires are wrapped

in soft rubber which at great depths is highly compressed. By their use, visibility is quite good at a depth of 400 ft. and photographs have been obtained at this depth. They are also used for salvage operations. Lamps at voltages which give them a life of about an hour only are used for photographic work. At still higher pressures we get the 'photoflash' lamp which is only used for instantaneous flashes. When used in a bulb of special blue-coloured glass, the blinding effect is negligible and the photographic effect is little impaired. In Europe, remarkable progress has been made in developing electric discharge lamps. In the United States, sodium and mercury lamps are used; the latter is the more popular for interior lighting. The Statue of Liberty in New York Harbour is flood-lighted, the intensity of the illumination being 30 foot-candles. Golf courses are now being lighted and playing at night is proving popular. A few courses are lighted by filament lamps, the consumption being 5–10 kilowatts per hole. Steam and sailing yachts are sometimes flood-lighted, the canvas and the funnels being illuminated. As well as being decorative, this adds to their safety. One of the chief uses of ultra-violet energy is for the purification of liquids. By means of a cinema film, the purification of water by killing the bacteria with ultra-violet rays was shown.

Steam Tables

WHEN a conference of American engineers and physicists decided in 1921 on a research programme to produce more accurate data on the properties of steam, investigation of the properties of saturated steam was assigned to the National Bureau of Standards. Recent research both in America and in Great Britain has increased the available data, and in the July issue of the *Journal of Research* of the Bureau, Messrs. N. S. Osborne and C. H. Meyers give the results of their examination of it in the form of tables of the saturation pressure and of its rate of change with temperature in both atmospheres and kilograms per square cm. units for each degree Centigrade and Fahrenheit between $-5°$ C. and 374° C., the critical point being 374·1° C. The results of Holborn, Scheel and Henning of the Reichsanstalt, Egerton and Callendar, Osborne and his colleagues of the Bureau, Keyes and his colleagues of the Massachusetts Institute of Technology have all been utilised. At temperatures below 200° C. they differ very little from each other, and even near the critical temperature the differences are less than 0·1 per cent of the pressure, which is nearly 218 atmospheres. Both saturation pressure and its variation with temperature are expressed in terms of absolute temperature by empirical formulæ modified from those in common use, but it is not intended that for practical purposes the formulæ should replace the tables.

The University in the New Age

MR. MAYCOCK, in a contribution to the *Hibbert Journal* (**32**, No. 4), hopes that the universities may save us from an anarchic and materialistic society "where all will live for the moment in a chaos of pure sensation". This salvation will be possible only if the universities have due reverence for the traditions of their past, and for the value and dignity of learning. A survey of their history shows that they have to-day a great opportunity. They are once more as influential as they were in the Middle Ages; all that is wanting is an equivalent of the medieval synthesis. Mr. Maycock sees hope for this in the present-day pre-occupation with the social sciences, since these lead more readily to integration than the nineteenth century development of physical science. Over-specialisation has put learning out of touch with life, and has endangered our social order, and this the universities can remedy, not by becoming technical schools but by teaching an attitude to knowledge; the new age needs to recover the spiritual values of the Middle Ages, and, like Aquinas, to call those men wise "who control things rightly and set them in order".

Nations and the Public Health

INTERNATIONAL co-operation in public health is assuming much importance at the present time, and formed the subject of Sir George Buchanan's Milroy Lectures, delivered before the Royal College of Physicians, London, in February and March last (reprinted from the *Lancet*, April and May, 1934, pp. 879, 935, and 992). After some introductory remarks respecting the Rockefeller Foundation, the Red Cross and League of Red Cross Societies, he proceeds to survey some of the public health activities of the League of Nations, and of the Office International d'Hygiène Publique, Paris. The former have included health missions to various countries, international regulation of opium and drugs of addiction, statistics and radiological treatment of cancer, standardisation of biological products such as therapeutic sera, and inquiries into the laboratory procedures employed in the Wassermann test for syphilis. At the International Office in Paris, a permanent committee of delegates, representing fifty-one Governments, meets in regular half-yearly sessions, and is concerned with the prevention of plague, cholera and some other communicable diseases. It drafted the International Sanitary Convention, 1926, which deals with quarantine and de-ratisation of ships, it co-ordinates the sanitary control of the Mecca Pilgrimage, and it drew up the International Sanitary Convention for Aerial Navigation, 1933, which has already been signed by many nations. These international meetings also serve to establish a personal relationship with fellow-workers overseas and in foreign countries, and are invaluable as a time-saver when dealing with common problems.

Meteorology of India

IN a lecture delivered to the Royal Society of Arts on April 13, an account of which appears in the *Journal* of the Society (**82**, No. 4256), Mr. J. H. Field discussed the meteorology of India. In his lecture, Mr. Field gave interesting accounts of recent developments, such as the detection of cyclones at sea by the indications of seismographs, a subject developed

by Dr. S. K. Banerji with the aid of a Milne-Shaw seismograph located in Bombay, and also of recent researches into the system of upper winds over India. At the present time, maps are prepared daily showing the wind systems at seven different levels between 500 metres and 6,000 metres above the ground. These maps are of great service to aviation. Speaking of the dangers to flying in India, Mr. Field pointed out that these include most of those encountered in Europe with the addition of dust storms, and of hail storms that at their worst probably surpass any that occur in Europe ; he spoke of cases where hail stones of at least five inches diameter have destroyed Indian villages and killed every living creature in them. A point that emerged very clearly was the inadequacy of the financial provision for dealing with the requirements of aviation over the Indian section of the air route from England to Australia. The service was described as a "skeleton provision, materially below the standards recommended in the International Air Convention". This, fortunately, can be regarded as a matter that in the forward march of aviation must inevitably be set right, sooner or later. It is to be hoped that realisation of the importance of more complete meteorological information will not be delayed until after numerous fatal accidents have directed public attention to the subject.

Plant Collecting in Asia

MR. F. KINGDON WARD contributes the first of a series of articles about his twelfth expedition in Asia to the *Gardeners' Chronicle* of August 4. His object was, of course, to find new plants with which to enhance the beauty of gardens, and to add to the knowledge of the systematic botany of Asia. He was accompanied on part of the journey by Mr. R. Kaulbach, and by Mr. Brooks-Carrington, who is a kinematographer sent out by Ray-Col British Corporation Ltd. Ten thousand feet of colour film illustrating "Plant Hunting on the Edge of the World" have been prepared, and will shortly be on view in Great Britain. Mr. Kingdon Ward's journey began at Calcutta on February 25, 1933 ; thence he journeyed to Sadiya by way of Shillong, the capital of Assam. From Sadiya he went to Rima and beyond, to the snow range, entering the unexplored regions beyond Shugden Gompa. Returning to Zayul, he explored that province, and finally returned from Tibet to Assam via the Delei valley. A number of new plants were collected on the expedition, and will be described in subsequent instalments of the narrative, which is also highly descriptive of the country traversed.

Pollen Carried by Dust Storms

IN connexion with a note published in NATURE of June 16, p. 905, on the high proportion of pollen found in the dust storms experienced this year in the United States, Mr. K. Biswas, curator of the Herbarium, Royal Botanic Garden, Calcutta, directs attention to the "Puspa-bristi" (rain of flowers) frequently noticed in India. During late February and March, which is the flowering period of a large number of trees in the plains and *terai* of the Eastern Himalayas, the pollen seems often to be carried up to high levels in the hot air and then distributed over a wide area by dust storms. The pollen settles later with the dew or rain in drops of liquid, which dry upon the foliage of the plants leaving residues of pollen grains.

Useful Birds

THE Royal Society for the Protection of Birds has just added to its attractive series of coloured food-charts of birds, pictorial representations of the proportions of useful, harmful and neutral work (so far as human interests are concerned) done by the jackdaw, kestrel, nightjar and yellow-hammer. The cards, which are issued at 4*d*. each post free, or 4*s*. 4*d*. for the series of 16, are telling exhibits for use in museums or school-rooms. Recently the Ministry of Agriculture and Fisheries has issued Advisory Leaflets describing the characteristics and habits of the barn owl, woodpeckers, starling, swallow, martins and swift, lapwing and wagtails. A leaflet in the same series describes some simple nest boxes for the encouragement of the breeding of useful birds in gardens, orchards and allotments. They cost 1*d*. net each.

Dinosaur Discovery in Wyoming

DR. BARNUM BROWN, leader of the American Museum Sinclair Dinosaur Expedition, has discovered (according to Science Service, Washington, D.C.) an extraordinarily rich collection of fossil dinosaurs in Red Gulch Quarry, twenty-five miles east of Greybull, Wyoming. The number of skeletons unearthed up to the end of July was twelve, and Dr. Brown believes that they represent the remains of a herd of gigantic sauropod dinosaurs, caught in drying lakes and swamps, during an extended drought in the area some 125 millions of years ago.

An Automatic Firedamp Recorder

THE Safety in Mines Research Board has issued as Paper No. 86 an account of an automatic firedamp recorder, reference to which has already been made and a picture of the plant published in the twelfth annual report of the Safety in Mines Research Board, whilst the recorder had previously been described in the *Transactions of the Institution of Mining Engineers*. The present paper, however, gives the construction in more detail than either of the previous publications above referred to. The paper is by Mr. H. Lloyd, who designed the instrument in question.

Stemming Materials

THE Safety in Mines Research Board has just published Paper No. 84 dealing with stemming materials and written by Prof. J. A. S. Ritson and Mr. H. Stafford. This paper is practically a résumé of a number of papers and observations which Prof. Ritson and his colleagues have been carrying out for a number of years. The first paper was published by them in the *Transactions of the Institution of*

Mining Engineers of 1930, and they have continued their work practically up to the present. They find that sand between 1/10 in. and 1/100 in. is the most effective material, and that a mixture of sand and clay (three of the latter to one of the former) is practically as efficient as sand alone and is much more convenient for stemming horizontal shot holes. To enable the material to be stored without getting dry, the authors recommend 3–5 per cent of calcium chloride to be added, and they state that by the use of a sand and clay stemming, blown-out shots can be prevented, the amount of fumes can be reduced, and up to one third of the cost of the explosives can be saved. From the practical point of view this paper, published at 6*d*., is of very great value.

The Sir John Cass Technical Institute

THE Sir John Cass Technical Institute, Aldgate, in the City of London, announces the completion of a new wing adding some seventy-five feet to the frontage of the main building, and providing accommodation for new library and reading rooms, a students' common room, a geology room and museum, and laboratories for metallurgy and pyrometry, assaying and mechanical testing and engraving, and a research laboratory. The new wing is to be opened on October 10 by the Earl of Athlone, Chancellor of the University of London. The Institute provides instruction in pure science as well as in the biochemistry of fermentation, petroleum technology, and fuel technology, in arts and crafts, tailoring and languages, and includes a Nautical School. Sir John Cass, to whose charitable interest in education the Institute owes its origin, was an alderman of the Ward of Portsoken from 1710 until 1718 and sat in Parliament as one of the representatives of the City of London.

Social Hygiene Congress

A CONGRESS of social hygiene will be held at Lyons on October 7–9, with M. Edouard Herriot as president of honour and M. Risler, member of the Institut de France, as president. The following papers among others will be read: Thirty years' campaign against tuberculosis, by Prof. Courmont; the work done by the Rhône Departmental Committee in the campaign against tuberculosis, by Dr. Mouisset; the efforts made on behalf of cheap housing at Lyons, by M. Lévy; the Lyons regional centre and the campaign against venereal diseases, by Prof. Nicolas; biological and medical foundations for the campaign against infantile mortality, by Prof. Mouriquand; the municipal work for infantile and maternal protection at Lyons, by Drs. Vigne, Trillat and Gardère; the Franco-American foundation for children, its work and results, by Prof. Lépine; the social hygiene centre of the school of nurses and health visitors of Lyons, by Dr. Charles Gardère; and the work of the anti-cancer centre at Lyons, by Prof. Bérard. Further information can be obtained from the general secretary, Prof. Rochaix, 61 rue Pasteur, Lyons, or from Alliance d'Hygiène Sociale, 5 rue Las-Casas, Paris.

Announcements

BY an order of the Committee of Privy Council, the Most Hon. the Marquess of Linlithgow is appointed a member of the Medical Research Council on the retirement of the Right Hon. the Viscount D'Abernon. Lord Linlithgow will succeed Lord D'Abernon as chairman of the Council.

ON Wednesday, October 3, Prof. G. Barger, professor of chemistry in relation to medicine in the University of Edinburgh, will deliver the inaugural sessional address of the Pharmaceutical Society of Great Britain at its School at 17 Bloomsbury Square, London, W.C.1.

EARLY in 1935, a new international botanical yearbook, to be known as *Chronica Botanica*, will be published by Fr. Verdoorn, P.O. Box 8, Leyden, Holland. The journal will include important dates of the past, present and future of interest to botanists; announcements and reports of the International Botanical Congress, and other international societies, congresses, etc.; elections of officers and the reports of botanical societies; a survey of pure and applied botany during the previous year; and correspondence.

"How to Use a Medical Library" is the title of a booklet by Leslie T. Morton, assistant in the library of the Royal Society of Medicine (London: John Bale, Sons and Danielsson, Ltd., 2*s*. 6*d*. net). It should prove a useful guide for research workers and others to the sources of information respecting medical literature and the compilation of medical bibliographies. A list of the principal medical indexes and abstracting journals is included, together with an account of the facilities afforded in medical libraries in Great Britain.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant for work on electrical equipment for aircraft in the Directorate of Technical Development—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Oct. 3). An assistant investigator of coal measure strata, in the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Cromwell House, Dean Stanley Street, London, S.W.1 (Oct. 6). A mechanical engineer in the Department of the Chief Officer, London Fire Brigade—The Clerk of the Council, County Hall, Westminster Bridge, S.E.1 (Oct. 15). A permanent advisory economist at Seale-Hayne Agricultural College, Newton Abbot, Devon—The Secretary. A head of the Department of Mechanical Engineering at the Municipal Technical School, Gamble Institute, St. Helens—The Secretary for Education, Education Office, St. Helens. A teaching scholar in the Department of Botany, University of Birmingham—The Secretary. A technical assistant in the Department of Economics, South Eastern Agricultural College, Wye, Kent—The Secretary.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Seeing in the Ultra-Violet

ACCORDING to different authors[1,2], under appropriate conditions seeing is possible in the ultra-violet down to a wave-length as small as 3100 A. This fact has been confirmed on 21 persons (age 25–50 years) using as light sources discharge tubes containing (1) high-pressure mercury, (2) low-pressure cadmium and zinc (both in neon). The tubes were of quartz, 15 mm. × 120 mm. Visible light and short waves (<2700) were cut out by a red purple corex filter. Using one or more filters (each 5 mm.) the intensity of the Hg line 4047 relative to 3650 and 3130 could be varied within wide limits. A small monochromator

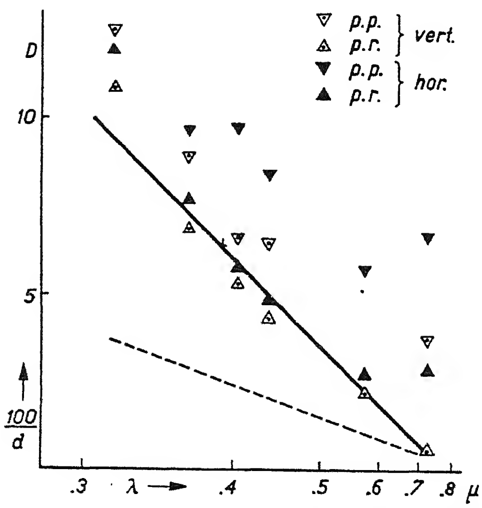

FIG. 1. Distance in dioptres of the *punctum remotum* and *proximum* of the author's left eye for vertical and horizontal focal line, λ 7080–3130. The dotted line refers to the refractivity of water (Listings eye).

(without second slit) was used to separate the different wave-lengths. As a result, the visibility for λ = 3650 relative to 4047 could be determined. It was also possible to estimate the visibility for 3130.

The values are very different for different persons.

$$V_{3650}/V_{4047} = 0{\cdot}015 - 0{\cdot}0003$$
$$V_{3130}/V_{4047} = 0{\cdot}005 - 0{\cdot}000004$$

One person could not see 3650, three persons were unable to see 3130. Even the most sensitive persons could not see the Zn line 3076. The Zn triplet 3345–3282, the Cd triplet 3612–3403 and the Cd line 3261 were seen by them with great ease. The description which these persons gave of the colour is very remarkable. They described it as clear blue, whereas the Hg line 4047 and the Zn line 4057 were described as violet. It seemed to them as if the succession in the spectrum was reversed[3]. To myself the colour appeared more greyish, although with a hue distinctly bluer than that of the recognised 'violet' lines (my visibilities are 0·0003 and 0·00002). The intensities used (expressed in mwatt/cm.² steradian) were

Hg	4047 (36)	3650 (60)	3341 (5)	3130 (50)
Cd	3612 (8)	3466 (8)	3403 (3)	3261 (100)
Zn	3345 – 3282 (10)	3076 (10)		

At the same time the dispersion of the eye could be studied by determining the distance (*d*) for which the image of the slit in a certain wave-length is seen sharply with the unaccommodated and well-accommodated eye respectively (*punctum remotum* and *proximum*). The reciprocal of the *p.r.* distance proved to be a nearly linear function of 1/λ from λ = 7082 to λ = 3130 A. For an eye which is emmetropic in the red, the degree of myopy at λ = 3130 A. amounts to about 10 D. From this it results that the dispersion in the region covered by the measurements is about 2½ times that of water. A slight indication of anomalous dispersion at λ = 3130 is present. By adjusting a horizontal cross wire perpendicular to the slit, the influence of astigmatism could be investigated. The accompanying diagram (Fig. 1) shows the results for my own left eye, which happens to be astigmatic with a nearly vertical axis.

From the description of these experiments, it will be clear that real retinal vision is observed and not the fluorescence of the other parts of the eye such as the lens, which of course was also very strong.

Whether the retinal process is due to the cones or to the rods and if fluorescence of the retina plays a rôle are still open questions[4].

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Aug. 25.

[1] Helmholtz, cf. Kayser, "Hb. d. Spektroskopie", 1, 600; 1900.
[2] Nutting, "Outlines of Applied Optics". Cf. W. Graham, *J. Opt. Soc. Am.*, 6, 605; 1922.
[3] cf. Helmholtz, "Physiol. Optik", 3 Aufl., 2, 61.
[4] Helmholtz, l.c.

Detection of Neutrons Liberated from Beryllium by Gamma Rays: a New Technique for Inducing Radioactivity

WE have observed that a radiation emitted from beryllium under the influence of radium gamma rays excites induced radioactivity in iodine, and we conclude that neutrons are liberated from beryllium by gamma rays.

Chadwick and Goldhaber were the first to observe a nuclear disintegration due to the action of gamma rays. In their pioneer experiment[1], they used a small ionisation chamber filled with heavy hydrogen and observed that protons were ejected from the heavy hydrogen under the influence of gamma rays from thorium C. Their method can be used for the detection of the gamma ray disintegrations of other elements, as such a disintegration would generally be accompanied by the ejection of *charged nuclei* which their method is designed to detect. On the other hand, apart from the unique case of heavy hydrogen, their method does not appear to give direct evidence on *neutron* radiations, which may in certain cases accompany gamma ray disintegrations.

It appeared to us of interest to search for such neutron radiations, and we thought that the Fermi effect might conveniently be used as an indicator of their presence. For certain reasons, we chose to use as indicators elements which, like iodine, are trans-

muted in the Fermi effect into their own radioactive isotopes.

In order to make our test more sensitive, we applied in this work the new principle of isotopic separation which we recently described[2]. In the present experiment we have used iodine as indicator, and separated radio-iodine from the bombarded iodine.

In one experiment we surrounded 150 mgm. of radium (in sealed containers of 1·0 mm. platinum filtration) with 25 gm. of beryllium, which was further surrounded by 100 c.c. ethyl iodide. The silver iodide precipitate obtained after irradiation from the ethyl iodide showed an activity decaying with a half period of 30 minutes. In spite of the inefficient geometrical arrangement of the beryllium in this experiment, we obtained from the active precipitate 200 impulses of the Geiger-Müller beta ray counter per minute. In the control experiment omitting the beryllium, we obtained less than 12 impulses per minute. The effect observed is sufficiently strong to be easily detected without separating chemically the radioactive element.

Our observations show that it will be possible to make experiments on induced radioactivity by using the gamma rays of sealed radium containers, which are available in many hospitals for therapeutic purposes. Further, it will be possible to have very much stronger sources of neutrons and to produce thereby larger quantities of radioactive elements by using X-rays from high-voltage electron tubes.

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[1] NATURE, 134, 237, Aug. 18, 1934.
[2] NATURE, 134, 462, Sept. 22, 1934.

Annihilation Radiation from Paraffin Bombarded with Neutrons

LEA[1] has shown that paraffin when bombarded with neutrons from a (Po + Be) source emits heterogeneous γ-radiation of quantum energy $2–4 \times 10^6$ e.v. By bombarding graphite with the same radiation and by testing paraffin with the γ-radiation of ThC″ it was shown that the effect was due to impacts between the bombarding neutrons and protons and it was, therefore, suggested that the γ-radiation arose as a result of the union of a proton and neutron to form a diplon.

However, if the γ-radiation arose in this manner, evidence of the recoil tracks of diplons should be found by means of the expansion chamber and stereoscopic photography, and the short tracks due to diplons should be mainly directed away from the neutron source. But the distribution found by Auger and Monod-Herzen[2] shows, on the contrary, a minimum in this direction, and in addition observations by Auger[3] have indicated that the tracks are due to recoil protons. Auger[3], and more recently Chadwick and Goldhaber[4], have therefore concluded that the γ-radiation does not arise as suggested. Auger suggests that it arises as a result of the excitation of the protons by inelastic collisions with the bombarding neutrons, although this could only involve the neutrons of highest energy or those which could excite the proton to higher energy states by resonance.

Perrin[5] has shown, however, that a particle of mass M_1 may produce a pair of electrons on colliding with a particle at rest of mass M_2 if its kinetic energy is greater than $2m_0c^2\dfrac{(M_1 + M_2 + m_0)}{M_1} = 2 \times 10^6$ e.v. for particles of equal mass, which is much greater than that of the electron.

Thus, as the neutrons used by Lea and Auger had energies $2–4 \times 10^6$ e.v., electron pairs might be produced as a result of collisions between the incident particles and the protons. The negative electron of the pair being produced in the positive nuclear field of the proton might be captured, the positron of the proton being annihilated with this electron to produce a quantum of γ-radiation, the proton being thus transformed into a neutron. The heterogeneity of the γ-rays observed would then be due to the fact that there are four bodies involved in the action, the incident neutron, the newly-formed neutron, the recoil positive electron of the pair and the quantum.

If this explanation is correct we should also expect to observe γ-radiation of energy $0{\cdot}5 \times 10^6$ e.v. due to the annihilation of the positron produced. In addition, the minimum number of recoil protons in the forward direction is thus due to the transformation of these particles into neutrons, as the probability of the action would be much greater in cases of direct impact.

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Exeter.

[1] Lea, NATURE, 133, 24, Jan. 6, 1934.
[2] Auger and Monod-Herzen, *Comptes rendus*, 196, 543; 1933.
[3] Auger, *Comptes rendus*, 198, 365; 1934.
[4] Chadwick and Goldhaber, NATURE, 134, 237, Aug. 18, 1934.
[5] Perrin, *Comptes rendus*, 197, 1302; 1933.

Electric Arcs with Fused Metals and Salts as Electrodes

ONE of us (M.P.) announced in a letter to NATURE two years ago[1] that electric arcs had been obtained between electrodes of substances which are insulators at ordinary temperature. By heating glass, porcelain, quartz, etc., to a very high temperature, it is possible to start the arc between electrodes of these substances.

We have now extended these researches. Metals and metallic salts, fused in a carbon crucible—fusion is brought about by previously starting the arc between the negative carbon above and the positive carbon crucible—which is connected with the positive or negative pole of a powerful battery of accumulators, can be positive or negative electrodes of an arc.

The properties of these arcs vary greatly. For example, with molten sodium, or sodium salts as positive electrode, the arc appears spectroscopically at its start, as a flame. The spectrum is restricted to D_1D_2, which appears as a single line. Presently, the spectrum becomes richer. The D doublet appears as a very large, luminous line, that sometimes broadens to some thousands of angstroms, so that it invades all the visible region of the spectrum, with a large zone of autoinversion at the centre, which reaches, at times, a width of 500 A. Moreover, the lines of the accessory series also appear and are autoinverted.

When the salt, or the metal, begins to boil, the density of vapour surrounding the arc is very great. The arc has a characteristic aspect like that of an enormous, very luminous flame, sometimes 20 or 30 cm. high, which completely surrounds the overhanging negative carbon. The degree of spectroscopic excitation increases little by little until the arc (especially with molten salts) opens a passage, attaching itself on the carbon of the crucible lying below. The positive crater then becomes extremely narrow; and the arc takes on the appearance of an ultra-forced arc, with a long, very luminous dart, which also presents a spectrum of a high excitation. In such conditions it seems that some lines (for example, *D*) present some spectroscopic fission, with which we shall probably deal later on.

The arc with liquid copper as positive presents a minute crater which moves with extreme rapidity on the molten metal. All the bulk of the latter very soon begins to boil, especially if the other electrode possesses many negative bases[2]. Then the number of autoinverted lines is great. Also some of the carbon and cyanogen bands are inverted. Arcs with positive boiling porcelain are very white and luminous. The crater involves the whole crucible (that is, many square centimetres in extent). The ultra-violet spectrum abounds in lines, many of which are auto-inverted. The lines of aluminium are more intense in this case than in the case of arcs having a positive electrode of boiling aluminium.

The electric and spectroscopic properties of these arcs will be more fully discussed in *Nuovo Cimento*.

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LUIGI BARBANTI SILVA.
Istituto di Fisica della R. Università,
Modena. Aug. 3.

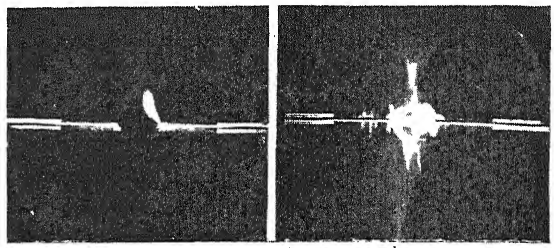
[1] M. Pierucci, NATURE, 129, 724, May 14, 1932.
[2] M. Pierucci, *Nuovo Cimento*, 1925 and 1932.

Spark Investigation by the Wilson Chamber

SEVERAL years ago, one of the present writers (U. N.) engaged in a study concerning the form of long electric sparks at the laboratory of the Institute of Physical and Chemical Research in Tokyo under Prof. Terada. We succeeded then, by using a quartz-fluorite lens, in taking a photograph of the brush discharge immediately preceding the main spark[1]. This preceding discharge is rich in ultra-violet light, and more complicated and extended in its form than the succeeding main spark, giving an aspect as appendages to the luminous spark track. This result led us to look for the other form of discharge which cannot be photographed even with the quartz-fluorite lens. The use of Prof. Wilson's cloud chamber is at our present stage of knowledge the only method suitable for observing a process of discharge that is not accompanied by any luminous phenomenon. We then tried, on the suggestion of Prof. T. Terada, to take a Wilson photograph of the ions produced by a spark, but did not succeed in obtaining a satisfactory one. Later on, in the course of conversation with Prof. C. T. R. Wilson at Cambridge, I was given a great deal of advice on this problem and decided to take up this subject again.

We studied the formation and distribution of ions produced at the initial stages of spark formation. A surge was sent from an ordinary impulse generator to the electrodes enclosed in the cloud chamber, and its front was cut down by a spark discharge through a secondary gap l inserted parallel to the electrodes. The electrical system was similar to that used by Torok and others for photographing the suppressed spark. As high-voltage source, a Wommelsdorf's influence machine was used. By varying l we could see the successive stages of formation of ions in the preliminary stage of a spark.

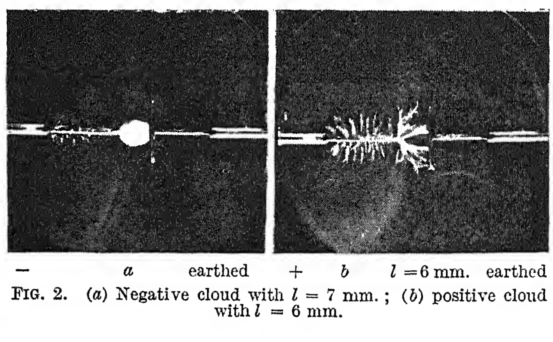
The first series of experiments was carried out with nickel electrodes 1·7 mm. in diameter and rounded to hemispherical shape at the ends, gap distance being kept at 2·0 cm. The voltage impulse was sent just after the expansion of the chamber was completed and an illuminating spark was passed



+ *a* − + *b* −

FIG. 1. Positive clouds with (*a*) l = 3 mm. and (*b*) l = 10 mm.

a few hundredths of a second after the impulse was applied, the synchronisation being done by a pendulum. With $l = 3·0$ mm., an ion cloud of spindle shape begins to appear from the negative electrode, but a cloud from the positive electrode does not appear so easily, and with higher voltage (say, l = 7·0 mm.), it begins to extend from the electrode. The positive cloud consists of a bundle of branched or non-branched streamers, in form resembling a positive Lichtenberg's figure. In this series of experiments all these clouds appeared as if they were drifted to a direction perpendicular to the gap line, as shown in Fig. 1. This effect was found to be due to the potential difference between the wall



− *a* earthed + *b* l = 6 mm. earthed

FIG. 2. (*a*) Negative cloud with l = 7 mm.; (*b*) positive cloud with l = 6 mm.

of the chamber and the electrodes after the impulse was applied. When using an influence machine without connecting one side to earth, the potential distribution of the two electrodes is not symmetrical and the surge circuit can be at higher potential than the surrounding earth just after the discharge. This effect could be avoided by connecting the surge circuit to earth through water resistance. The results obtained up to this stage were published in January[2]. Recently, we have seen a letter from Drs. Snoddy and Bradley[3], which states that they are engaged on an almost identical investigation.

The second series of experiments was carried out with a gap of a needle electrode and an earthed

plate, the distance chosen being 1·5 cm., in order to see clearly the difference between the positive and negative clouds. Typical photographs are reproduced in Fig. 2. The negative cloud is of a diffuse character, and usually forms a thick spindle (Fig. 2*a*), but is sometimes divided into a few thin spindles still diffuse in character. Sharp tracks appearing on the surface of the needle electrode wire seem to be positive tracks resulting from an electrical oscillation of the circuit excited by a spark at gap *l*. The characteristic of the positive clouds is seen clearly in Fig. 2*b*. The streamer or canal of ionisation is of a fair width but the boundary is very sharply defined, terminating in a pointed end. Most of them are branched and show the characteristics of the positive figure obtained on a photographic plate. In some electrical conditions these streamers become very thin and sharply defined, when they tend to be more sinuous in form.

In order to get some idea of the nature of the surge producing these ion clouds, a box for recording Lichtenberg's figure was inserted parallel to the chamber electrodes. Those figures showed some electrical oscillations of the circuit. We are endeavouring to obtain more definite results by improving the electrical circuit.

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June 22.

[1] T. Terada, U. Nakaya and R. Yamamoto, *Sci. Pap. Inst. Phy. Chem. Res.*, Tokyo, **8–16**; 1928–1931.
[2] U. Nakaya and F. Yamasaki, *Kwagaku*, Tokyo, **4**, Jan. 1, 1934.
[3] L. B. Snoddy and C. D. Bradley, *Phys. Rev.*, **45**, March 15, 1934

Anomalous Diamagnetism of Selenium

THE diamagnetic susceptibilities of samples of selenium powdered to different degrees of fineness have been measured with a magnetic balance of the Wilson type. The diamagnetism of the samples decreases as the fineness of the powdering is increased, and at a certain stage the sample becomes paramagnetic. The paramagnetic value increases on further powdering. Further, the colloidal selenium has been found to be more paramagnetic than any of the powdered samples.

A considerable amount of work on the susceptibility of the colloidal powder of bismuth and other metals (antimony, silver, gold) has been done by Vaidyanathan[1], Rao[2] and others. They find that, with the decrease of the size of the particles, the diamagnetic susceptibility also decreases. Mathur and Varma[3] have shown that a large part of the decrease in diamagnetism of bismuth is due to oxidation, while Rao still finds a change even when the oxide is removed by suitable means.

Consequently, the powdered samples of selenium were washed with absolute alcohol in which the selenium oxides are known to dissolve, and their susceptibilities were re-determined. It was found that the paramagnetism still persisted in all the samples so far examined.

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[1] Vaidyanathan, *Indian J. Phys.*, **5**, 559; 1930.
[2] Rao, *ibid.*, **6**, 241; 1931.
[3] Mathur and Varma, *ibid.*, **6**, 181; 1931.

Binding Energies of the Neutron and the Proton

PROCEEDING from the assumption that both the proton and the neutron are of elementary nature, D. Iwanenko[1] concludes that the sum of the binding energies of the proton and the neutron equals $2mc^2$ (where m is the mass of the electron) and that the difference between these quantities cannot exceed mc^2, hence the mass defect of the neutron (or proton) cannot exceed this value.

The experimental data[2] lead us to suppose that the transformation of a proton into a neutron or vice versa can result only from the interaction of the nuclear particles and photons, by which the 'electrofission' of a photon into an electron and a positron takes place[3].

Consequently, the energy balance of the processes of transformation of proton into neutron, or neutron into proton, may be represented by the following equations:

$$n + 2mc^2 = n + e^+ + e^- = p + E_p + e^- \qquad (1)$$
$$p + 2mc^2 = p + e^+ + e^- = n + E_n + e^+ \qquad (2)$$

where the letters designate the energies of the neutron (n), proton (p), positron (e^+), electron (e^-); m is the mass of the electron, E_p the binding energy of the proton, E_n the binding energy of the neutron.

Adding equations (1) and (2) we immediately get Iwanenko's equation:

$$E_n + E_p = 2mc^2 \qquad (3)$$

Subtracting equation (1) from (2) we get:

$$E_n - E_p = 2(p - n) \qquad (4)$$

Equations (3) and (4) give:

$$E_n = mc^2 + (p - n) \qquad (5)$$
$$E_p = mc^2 - (p - n) \qquad (6)$$

Thus the binding energies of the neutron and the proton may be calculated, if the masses of the proton the neutron are known exactly.

According to Chadwick[4], the mass of the neutron is 1·0067 ($O^{16} = 16$) which gives:

$$p - n = mc^2 \qquad (7)$$

If this definition of the neutron mass is correct, from equations (5), (6) and (7) it follows that:

$$E_n = 2mc^2$$
$$E_p = 0 \qquad (8)$$

From the fact that $E_p = 0$, we cannot draw conclusions about the instability of the proton or about the possibility of a spontaneous reaction $p \rightleftarrows n + e^+$.

If we agree with the above-mentioned assumption that the processes of mutual transformation of proton and neutron may take place only with the interaction of photons, equations (1) and (2) have to be rewritten as follows:

$$n + 2mc^2 = n + e^+ + e^- = p + e^- \qquad (1^1)$$
$$p + 2mc^2 = p + e^+ + e^- = n + 2mc^2 + e^+ \qquad (2^1)$$

The physical meaning of these equations is as follows:

Let us admit that a particle is interacting with a photon of the energy $h\nu$.

Let ν_0 be the frequency of a photon with the energy

$$h\nu_0 = 2mc^2 \qquad (9)$$

that is, $1{\cdot}02 \times 10^6$ e.v.

Then the energy balance of the transmutation of the neutron into a proton and an electron will be written as follows:

$$n + h\nu = n + e^+ + e^- + E^1 = p + e + E^1 \quad (10)$$

where

$$E^1 = h\nu - h\nu_0 = h\nu - 2mc^2 \quad (11)$$

The energy E^1 can be manifested in the form of the kinetic energy of the proton and the electron, or in the form of a quantum of radiation, the energy of which is

$$h\nu^1 = h\nu - h\nu_0 = h\nu - 1{\cdot}02 \times 10^6 \text{ e.v.} \quad (12)$$

(if the kinetic energies of the proton and the electron vanish).

The energy balance in the transmutation of a proton into a neutron and a positron is:

$$p + h\nu = p + e^+ + e^- + E^1 = n + e^+ + E^1 + h\nu_0 \quad (13)$$

where E^1 is also given by equation (11).

It therefore follows that if the scattering of γ-rays is accompanied by the transmutation of a neutron into a proton and an electron, the maximum hardness of the scattered rays is determined by equation (11). If the scattering of γ-rays is accompanied by the transmutation of a proton into a neutron and a positron, then a scattered component of $1{\cdot}02 \times 10^6$ e.v. appears.[5]

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Kiev.

[1] D. Iwanenko, *C.R. Acad. Sci. U.R.S.S.*
[2] F. Joliot, *C.R. Acad. Sci.*, **197**, 1623; 1933. J. Thibaud, *C.R. Acad. Sci.*, **197**, 1629; 1933.
[3] cf. M. N. Saha and D. S. Kothari, NATURE, **132**, 747, Nov. 11, 1933. **133**, 99, Jan. 20, 1934.
[4] J. Chadwick, *Proc. Roy. Soc.*, A, **142**, 1; 1933.
[5] L. H. Gray and G. T. P. Tarrant, *Proc. Roy. Soc.*, A, **143**, 681, 766; 1934.

Absorption Spectrum of Mercuric Sulphide

FROM a recent note by Iredale and Gibson[1], it seems that the authors have not been able to isolate the absorption spectrum of HgS, observed by me[2], from that of sulphur vapour in the range of temperatures they have worked, and they are of opinion that the absorption continua ascribed by me to HgS probably belong to sulphur vapour, because these lie in the neighbourhood of the absorption maxima of sulphur vapour at 4000 A. and 2670 A. when raised to the temperature of 400° C.

I have shown[3] how the HgS continua could be distinguished from those of sulphur. The HgS absorption spectrum was investigated chiefly at 500° C. and above. At this temperature there is always some decomposition of HgS, but the decomposed sulphur is in the S_2 state, not the S_8 state, so that it is impossible for the S_8 bands to manifest themselves at this temperature. The observed continuous absorption at 4450 A. could thus be only that of HgS. It would not matter if the concentration of the decomposed product (sulphur) be greater than that of the original compound (HgS), because there is still sufficient vapour of the compound to give good absorption. Now, the S_2 bands present at 500° C. or at a slightly higher temperature lie in the region 3500–3200 A., as seen from a separate experimental observation by me. This region was almost completely superposed by the continuous absorption by the sulphide. The second absorption at 3100 A. could only be due to HgS alone, as at this temperature no absorption due to sulphur is obtained in this region.

The next point refers to the constitution of HgS. I have not assumed an electronic structure like Hg $(^1S_0) - S\,(^3P)$ for HgS, as Iredale and Gibson seem to believe. My conclusions were based on the assumption that HgS is ionic, having a structure $Hg^{++}\,(^1S_0) - S^{--}(^1S_0)$ giving a $^1\Sigma$ state. Under the influence of light, both the electrons in S^{--} go to Hg^{++} simultaneously, giving two normal atoms, as I have already explained.

My results and views on the subject receive further support from the fact that the deduced value of the heat of dissociation of sulphur agrees very closely with some other values determined by other experimental methods.

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Aug. 1.

[1] NATURE, **133**, 985, June 30, 1934.
[2] Sen-Gupta, *Proc. Roy. Soc.*, A, **143**, 438; 1934.
[3] loc. cit.

Absorption Spectrum of Nitrous Oxide and Energy of Dissociation of Nitrogen

OWING to the importance of the determination of the energy of dissociation of nitrogen, it seems of interest to mention the value of D_{N_2} obtained by the study of the absorption spectrum of nitrous oxide (N_2O). This method, although an indirect one, gave a value of $D_{N_2} = 6{\cdot}9 \pm 0{\cdot}2$ volts, which is in fairly good agreement with the latest value of Herzberg and Sponer[1], $D_{N_2} = 7{\cdot}34$ volts.

We have measured the absorption spectrum of nitrous oxide at various temperatures and pressures. The limit of the continuous absorption is shifted towards the long wave-length with rising temperatures. From measurements made on photomicrometric curves for a wide range of temperatures, the limit of absorption extrapolated for $T_{\text{abs}} = 0$ was found to be 2140 ± 130 A.; this corresponds to the energy $D_{N_2O} = 132{,}000 \pm 8{,}000$ calories. We studied in Prof. Victor Henri's laboratory in Liège the photochemical decomposition of nitrous oxide by the radiations of a powerful cadmium spark filtered through layers of acetic acid of various concentrations. The absorption spectrum taken after the photochemical reaction showed the appearance of increasing amounts of nitric oxide; the mechanism of photochemical reaction can thus be explained as:

$$N_2O = NO + N.$$

Nitrous oxide being diamagnetic, according to Herzberg[2] its fundamental electronic state can only be a singlet ($^1\Sigma$). Such a state can only result from the adiabatic combination of individuals (NO and N) of equal multiplicity. The normal state of NO is $^2\Pi$; the normal state of the nitrogen atom is ^4S; N_2O cannot be formed by the adiabatic union of a normal NO molecule with a normal N atom. The next state of N is a metastable (^2D), $2{\cdot}27$ volts higher than (^4S). The photochemical decomposition of N_2O can thus be explained as:

$$N_2O\,(^1\Sigma) = NO\,(^2\Pi) + N\,(^2D) - 132{,}000 \text{ calories.}$$

This liberation of metastable atoms of nitrogen accounts for the shift of the absorption limit towards the long wave-lengths with rising temperatures

(transfer of energy to N_2O molecules not yet decomposed). Accepting this mechanism of decomposition, a series of simple thermochemical equations gives for the energy of decomposition of the normal nitrogen molecule into normal nitrogen atoms:

$$(D)_{N_2}(^1\Sigma) \rightarrow _{N_2}(^4S) = 6 \cdot 9 \pm 0 \cdot 2 \text{ volts} = 158{,}000 \pm 8{,}000 \text{ calories.}$$

This value is much lower than the 8·7 volts deduced by Dutta[3]; however, it is in good agreement with the latest results of Lozier[4] who gave 7·42 volts, of Kaplan[5], 7·42 volts, of Maier and Sponer[6], 6·7 to 7·2 volts and with the quite recent and safe value of Herzberg and Sponer[1], 7·34 volts.

It is hoped that the study of decomposition of nitrous oxide by electron impact, being made, combined with a careful study of the energy states of the decomposition products, will give a more accurate value of D_{N_2}.

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[1] Herzberg and Sponer, *Z. Phys.*, **26**, 1; 1934.
[2] Herzberg, *Z. phys. Chem.*, **17**, 68; 1932. *Ann. Phys.*, **5**, 677; 1934.
[3] Dutta, *Proc. Roy. Soc.*, A, **138**, 84; 1932.
[4] Lozier, *Phys. Rev.*, **45**, 841; 1934.
[5] Kaplan, *Phys. Rev.*, **45**, 757; 1934.
[6] Maier and Sponer, *Z. Phys.*, **89**, 431; 1934.

Photosynthesis of Amino Acids *in Vitro*

RECENTLY we have been successful in synthesising amino acids by exposing solutions of glycol or glucose and nitrates to sunlight for six to eight hours in presence of titania, used as a photocatalyst. The amino acids formed can be estimated colorimetrically by the valuable 'ninhydrin' (triketo-hydrindene hydrate: $C_6H_4{<}{}^{CO}_{CO}{>}C(OH)_2$) test. The following results were obtained by exposing to sunlight 100 c.c. of $N/2$ nitrate solutions and 5 gm. of glucose and 1 gm. of TiO_2 in open 250 c.c. pyrex glass beakers:

Time of exposure.	Amount of amino acids formed with different nitrates.		
	$N/2$ NH_4NO_3	$N/2$ $NaNO_3$	$N/2$ KNO_3
2 hours	nil	nil	0·000120 N
4 hours	0·000055 N	0·000274 N	0·00040 N
6 hours	0·00125 N	0·00040 N	0·00084 N
8 hours	0·001096 N	0·00024 N	0·00110 N
10 hours	0·00053 N	0·00020 N	0·00034 N
12 hours	nil	0·000185 N	0·00027 N
Dark	nil	nil	nil

The foregoing results show that the amount of amino acids photosynthesised is a maximum with ammonium nitrate and less with sodium nitrate. Moreover, the amino acid photosynthesised reaches a maximum value with increase of exposure and then falls off as the exposure is continued. After 15–20 hours exposure, very little amino acid is detected. The disappearance of the photosynthesised amino acids is due to their oxidation. When $N/2$ ammonium hydroxide or ammonium salt is substituted for the nitrate, no amino acid is photosynthesised, neither is there any amino acid formation in the dark. When the concentration of glucose is increased, the yield of amino acid is increased.

Tartaric acid, glycol, glycerol, arabinose, fructose, mannose, galactose, etc., can also be used instead of glucose in photosynthesising the amino acids, which are also formed when ammonium lactate is exposed to sunlight with TiO_2. Our experiments show that glycine is mainly formed with glycol and potassium nitrate, and arginine with glucose and potassium nitrate. Small amounts of amino acids are also synthesised by exposing solutions of glucose and nitrates with ammonium uranium carbonate used as a photocatalyst instead of TiO_2.

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The Philosophy of Sir James Jeans

THE excellent article by "H. D." with the above title[1] seems to me to require a little historical emendation. To regard science as a process of describing and co-ordinating sensations, and matter, space, time and so on as mental concepts introduced to make this co-ordination easier, is not characteristic of the new physics unless we are prepared to date the latter from the eighties of last century. Analyses on these lines were given quite explicitly by Mach then, and were further developed by Karl Pearson in "The Grammar of Science". Full acknowledgment to Mach was made by Einstein in his earlier papers, but both these pioneers seem to have got overlooked in later developments.

Nor am I satisfied that the new physics shows any more understanding of the nature of its methods than the old. One realism is disposed of merely to be replaced by a different realism; the relation to observation of parallel displacements and ψ-functions is as hazy as that of anything in the old physics. The problem of inference is still shirked; the a priori certainty of Euclidean mensuration and Newtonian dynamics has gone, but in its place we have the a priori certainty of the principle of general relativity. The new wine is there, and so are suitable bottles, though the latter are not as new as they were; but the old bottles are still being used.

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[1] NATURE, **134**, 337, Sept. 8, 1934.

I GLADLY join in Dr. Jeffreys's tribute to Mach and Karl Pearson, but I would suggest that these thinkers do not constitute 'science'. I do not think it can be gainsaid that the great majority of the most prominent scientific workers (Lord Kelvin, of course, springs to mind, and I think he is typical) did not regard science as Dr. Jeffreys defines it. Indeed, if the views of isolated individuals are to be accepted as 'science', I am not sure that we ought not to go back much further than the eighties of last century—at least to Newton, who regarded the absoluteness of motion as having an experimental and not an a priori foundation.

Space obviously precludes a proper discussion of Dr. Jeffreys's second paragraph, which I do not altogether understand. In speaking of "the new physics", is he still thinking only of the most far-seeing of new physicists, or has he tacitly changed to the general body? If the former, I certainly dissent; if the latter, it is a question of the degree of generality. My own view is that while, of course, "the old bottles are still being used", their use is far less general than it was thirty years ago, and the present generation of physicists is relatively so enlightened as to justify the statements of my article.

H. D.

Research Items

Kent's Cavern, Torquay. A report on the continued excavation of Kent's Cavern, Torquay, presented at Aberdeen by a Research Committee of Section H (Anthropology) of the British Association, states that an area of 160 sq. ft. of floor space, one half of which is beneath the 'Black Band' Magdalenian hearth worked by W. Pengelly between 1865 and 1880, has been excavated, the greatest depth reached being 10 ft. 6 in. below the general floor and 16 ft. below the old stalagmite floor. Remains of large animals were found between large fallen blocks of limestone. The animals usually found in the cave were present in good number, including horse, rhinoceros, deer, Irish deer, bear, fox, ox, badger, pine-marten and mammoth. Among the more interesting finds were three foot bones of deer, all articulating, three vertebræ of (?) rhinoceros in correct relation, a first phalanx of a human finger, 2 ft. below floor level, eight flint implements, a flint core, 3 in. by 2 in. by 2½ in., at a depth of 13 ft. 6 in. below the original floor level, small tines of deer, probably used as borers, and a quartzite pounder.

Archæology of Kahoolawe, Hawaii. A study of the archæology of Kahoolawe presents certain points of special interest in view of its sharply marked differences as a waterless, barren and desolate island, from the rest of Hawaii. A report based, in part on a study of the material in the Bernice P. Bishop Museum made in 1913 by Mr. J. F. G. Stokes, and in part on a recent survey by Mr. J. G. McAllister and Mr. F. H. Bryan is published as *Bulletin* 115 of the Museum. Attention was directed especially to the problem of the existence of a pre-Hawaiian culture. From the remains found, it is evident that there was on the island at one time a semi-permanent population. House foundations, and the ruins of religious structures are as permanent as anything found elsewhere in Hawaii: but environmental conditions were such that it seems unlikely that people could have inhabited the island for an indefinite period. Water is only procurable after heavy rains. At no time could there have been more than 150 people on the island. It was probably a base for fishing peoples, who established semi-permanent huts, numerous fishing shrines and two *heiaus* for propitiating the fish deities. The evidence of the remains and artefacts established these former inhabitants as Hawaiians at the time of discovery. Many of the usual remains of other islands, such as taro terraces and irrigation ditches, are absent. One unusual find was a family shrine, previously known only in the literature. The culture, however, is not typical of that of Hawaii as a whole, but represents the fishing phase only. The most important remains of this phase represented the technique of the manufacture of fish-hooks, a technique which had been forgotten. The offerings at the fishing shrines were also preserved in an exceptional condition.

Affinities of the Crab Fauna of California. An analysis of the Brachyuran fauna of the Gulf of California, by Steve A. Glassell, shows that an infusion of southern forms accounts for the main features of the fauna (*J. Washington Acad. Sci.*, 24, 296; 1934). The total number of species of cancroid, grapsoid and spider crabs in the Gulf of California is 197, a long list considering that only 181 marine decapods are known to occur within the 100 fathom line off the coast of California. Of the 197 species, 75 are indigenous to the Gulf, 96 are intrusive species from the south having their headquarters in the Panama region, and only 24 are northern intrusive forms. A complete list is given with indications of the centre of dispersal from which each species has migrated.

Phytoplankton of the *Discovery* Expedition. Mr. T. G. Hart in a recent monograph describes the phytoplankton collected by the *Discovery* Expedition from the south-west Atlantic and the Bellingshausen Sea, 1929–31 ("Discovery Reports", 8, pp. 1–268. Issued by the Discovery Committee, Colonial Office, London, on behalf of the Government of the Dependencies of the Falkland Islands. Cambridge, 1934). This forms the continuation of Prof. Hardy's pioneer work on the phytoplankton of South Georgia. The economic importance of the phytoplankton in these areas is great for it forms the greater part, if not the whole of the food of *Euphausia superba*, the euphausiid which is eaten in such huge quantities by the southern rorquals when migrating southwards in summer on their feeding migration. The diatoms *Fragilaria antarctica*, *Thalassiosira antarctica* and fragments of *Chaetoceros criophilum* were constantly found inside the *Euphausia*. Of the phytoplankton organisms, the diatoms preponderated in such a marked degree that the research was practically on the diatoms, the dinoflagellates and other groups being quite insignificant. Mr. Hart is of the opinion that nutrient salts are not at any time limiting factors within the Antarctic surface waters, and he emphasises the importance of physical factors—weather and currents, light, ice conditions and temperature. He attributes the seasonal variations and yearly fluctuations in the area investigated mainly to the following factors: the stabilisation of the upper layers when the ice melts, and, conversely, instability whether due to convection or wind action; transportation by surface currents and the possible return of resting spores by sub-surface currents followed by upwelling; the action of ice in various ways and of light intensity and duration.

Cruciform Muscle of Lamellibranchs. Mr. Alastair Graham (*Proc. Roy. Soc. Edin.*, 54, Part 1, No. 3) has made some very interesting investigations into the details of the structure known as the cruciform muscle with its attendant sense organ which occurs in certain bivalves. *Donax vittatus*, *Tellina crassa*, *Macoma balthica*, *Scrobicularia plana*, *Gari tellinella* and *Solecurtus scopula*, representing five distinct families, have been examined in this connexion. *Donax vittatus* differs from all the others, and agrees with *Tagelus dombeyi* as previously described by Hoffmann, in having the sense organ (or ciliated pit) opening into a small closed cavity. In all the others it opens to the exterior. As the author says, there must be some use for this organ, and he suggests that in those species where it is open it is a means of testing the purity of the water in which the mollusc finds itself, but it is difficult to accept this function for the closed organ of *Donax*, and for this form the question is left open. The open condition is probably the most primitive. Certain questions of nomenclature arise in these investigations, and the

author shows that the classification of Thiele where the Tellinacea, consisting of the families Tellinidæ, Semelidæ, Psammobiidæ and Donacidæ, and the Solenacea, which contains the sole family Solenidæ, are grouped together in the suborder Hemidapedonta, is more natural than that of Pelseneer, and also of Ridewood, where the Tellinidæ, Scrobiculariidæ (= Semelidæ) and the Donacidæ are grouped in the suborder Tellinacea, and the other two families, the Psammobiidæ (= Asaphidæ) and the Solenidæ, being placed in the Myacea. He also suggests that the Solenidæ be broken into two families, those without a cruciform muscle and those which possess one.

Classification of British Elms. It has been said with some truth that even good systematic botanists find considerable difficulty in the determination of species of the genus *Ulmus* (elm). A series of articles by Dr. Helen Bancroft appearing in the *Gardeners' Chronicle*, beginning with the issue of August 18, should do much to remove this incubus ("Notes on the Status and Nomenclature of the British Elms"). The account reports new work upon anatomical characters suitable for the differentiation of species, and on the origin of the forms occurring in Great Britain. The nomenclature of Elwes and Henry ("Trees of Great Britain and Ireland") is adopted as a basis, but some of the chief synonyms are also quoted. Descriptions of reasonably true species are to be dealt with first, and three have been described in the first two articles, namely, *Ulmus minor*, *U. montana* and *U. nitens*. Descriptions are given in considerable detail, and the distribution of each species is outlined. The account is to be continued, and if the present detail is maintained, should provide a valuable contribution to systematic botany.

The South Atlantic Earthquake of June 27, 1929. As this important earthquake (referred to in NATURE of August 18, p. 257) can have had few observers, an account sent to us by Commander T. M. Chaplin, Hydrographic Department, Admiralty, Whitehall, S.W.1, possesses considerable interest. At the time, he was engaged in carrying out coastal surveys for the Discovery Committee, and was occupying the Marine Biological Station at Grytviken in Cumberland Bay. On the morning of June 27, while drawing a chart, he was disturbed by a loud rumbling noise and vibration. The hanging electric lamps swung so as almost to touch the ceiling, and the glass chemical measures in the laboratory drawers were rolled about violently. The sound and shock suddenly ceased together at 12h. 51m. 30s., G.M.T., the duration of the shock being estimated at about 3 minutes. On looking out immediately after the earthquake, no agitation of the surface of the sea was observed and there appear to have been no changes in the land surface or in the soundings. The glaciers evidently calved with unusual frequency about this time, but this may have been due as much to the heavy rains that followed as to the earthquake itself.

The Arc Discharge. L. S. Ornstein and H. Brinkman discuss in *Physica*, 1, 9, July 1934, the mechanism of the electric arc. The study of the atomic and molecular spectra excited in the arc has shown that the gas atoms have a velocity distribution corresponding to a temperature of 4000°–7000° K, and in this paper the equilibrium between atoms and molecules, ions, electrons, and radiation is considered. In the arc stream the processes of excitation, dissociation and ionisation are mainly due to collisions between the *uncharged* particles. Radiation and collisions involving ions and electrons play only a subsidiary part, and the conditions are therefore similar to those which exist in a flame. In the neighbourhood of the electrodes and in the discharge at lower pressure, electron collisions become important. The relative importance of 'thermal ionisation' by collision between atoms and of electron impact provides a distinction between 'arc' and 'glow'.

Heavy Hydrogen and Heavy Oxygen. The *Journal of the American Chemical Society* (August, 1934) contains several short communications dealing with heavy hydrogen (deuterium, H^2). W. H. Claussen and J. H. Hildebrand have compared the vapour pressures of HF and H^2F, prepared by the action of hydrogen and deuterium on silver fluoride. Deuterium fluoride has the higher vapour pressure, the deviation being in the same direction as with the acetic acids. Both acetic and hydrofluoric acids are highly polymerised in the liquid phase. The exchange reaction between deuterium and water vapour on catalytic hydrogenating surfaces of chromium and zinc oxides, studied by H. S. Taylor and H. Diamond, shows that heavy hydrogen may rapidly be displaced by the light isotope in the moist gas in contact with catalytic surfaces. N. F. Hall, H. R. Wentzel and T. Smith find that the lower consolute temperature of nicotine and water is lowered, and the upper consolute temperature of phenol and water raised by increasing the deuterium content of the water. Some experiments on heavy oxygen, O^{18}, are reported by H. S. Taylor and A. J. Gould. W. R. Smythe has given the ratio $O^{16} : O^{18} = 503 \pm 10$ for the oxygen obtained by heating lead peroxide, and since the process involves a solid solution, there is a possibility of isotopic separation. Several specimens of the liberated gas, examined by W. Bleakney by the mass spectrograph, gave, however, practically the same ratio, $O^{16} : O^{18} = 468$ to 478. Measurements by Manian with gas from meteorites and potassium chlorate gave 514 ± 13. Oxygen from 30 per cent hydrogen peroxide and colloidal platinum gave 462 ± 8 and 426 ± 4 for initial and final specimens, indicating a separation of the isotopes, O^{18} being less rapidly liberated.

Recent Work on Relativity. Very few exact solutions of Einstein's equations are at present known. The most important, after Schwarzschild's statical form with spherical symmetry, is Levi-Civita's statical form with axial symmetry. In "Sur les ds^2 d'Einstein à symétrie axiale" (Hermann, 1934), J. Delsarte obtains a non-statical form with axial symmetry. It is hoped that this work gives the solution of the problem of two bodies moving in the same straight line. The mathematics reveals some unexpected connexions with certain problems in Euclidean infinitesimal geometry studied by Darboux. In a paper read recently in India before the United Provinces Academy of Sciences, the Hon. Sir Shah Mohammed Sulaiman, Chief Justice of the Allahabad High Court, put forward a modified theory of relativity. He claimed that this new theory incorporated Einstein's corrections to Newtonian mechanics without Einstein's complete abandonment of Newtonian principles. Moreover, it led to the conclusion that nebulæ can approach (as at least five are known to do) as well as recede, and that the universe is not exploding, but is stable.

The International Scientific Radio Union

THE fifth general assembly of the Union Radio Scientifique Internationale (U.R.S.I.) was held in London on September 11–19. This is the first occasion on which the Union has met in London, the previous general assemblies having been held in Brussels, Copenhagen and Washington. The congress was attended by nearly sixty delegates representing fourteen countries interested in the scientific aspects of radio communication. At the opening meeting, Prof. J. C. McLennan, vice-president of the Royal Society, welcomed the delegates at Burlington House on behalf of the Council, by the courtesy of which the rooms of the Society were made available for the business meeting of the congress.

Prof. W. H. Eccles acted as president of the general assembly, and in his opening address he described the origin of the Union in a meeting in Brussels held early in 1914, and arranged by Dr. R. B. Goldschmidt, now the general secretary. After the War, the U.R.S.I. was one of the first to be included under the International Council of Scientific Unions. The science of radio communication demands the attention of both the engineer and the physicist, and by its very nature it necessarily involves international co-operation. One example of the material results which have emerged from such co-operation in recent years is to be found in the remarkable progress in the precision of frequency measurement. In his presidential address to Commission I of the U.R.S.I., Dr. E. H. Rayner described the results of the comparison of the frequency standards of different countries. So far as Europe is concerned, these comparisons were carried out by employing the frequency standard of the National Physical Laboratory either to modulate waves radiated directly from the Laboratory's transmitting station, or with the co-operation of the B.B.C. to modulate the carrier wave of the Daventry broadcasting station. For the purpose of comparison with the United States, measurements have been made at the National Physical Laboratory of the standard frequency carrier wave emitted regularly by the Bureau of Standards. Experiments carried out in this manner have shown that the constancy and accuracy of apparatus in use for the measurement of radio frequency have reached a standard which would scarcely have been thought possible a few years ago. In two of these comparisons, measurements made in three different countries were in agreement to within one part in ten million, while it is considered that frequency measurements can be effected in a laboratory to about five times this accuracy (that is, 2 parts in 10^8). On a time scale, this accuracy corresponds to less than one second in a year, and in its continued development of the technique of frequency measurement, the U.R.S.I. will explore the possibilities of the application of this technique to other branches of science, such as astronomy and geodesy.

Another example of the very fruitful results of international co-operation was provided by the work of the International Polar Year Sub-Commission. This Sub-Commission was appointed under the presidency of Prof. E. V. Appleton, at the Copenhagen meeting of the U.R.S.I. in 1931, to arrange a programme of radio work during the second Polar Year, 1932–33. Six countries sent expeditions to carry out special observations in polar regions, and the results which have so far been analysed were discussed at the London congress. Prof. Appleton gave an account of the results obtained by the British expedition which was sent to Tromsö, and directed attention to the very marked effects of magnetic storms on the reflection of radio waves from the ionosphere. In addition to their scientific interest, such results have an important bearing on the practice of radio communication involving the passage of waves in high latitudes. Many other aspects of the propagation of electric waves around the earth were discussed at the meetings of Commission II of the U.R.S.I. presided over by Dr. J. H. Dellinger.

The third Commission of the Union deals with the subject of atmospherics, and a joint paper by Prof. E. V. Appleton and Mr. R. A. Watson Watt presented at the London meeting throws a new light on the manner in which these disturbances travel through the atmosphere. By the aid of photographic registration, the life-history of an atmospheric has been studied from its source at the lightning flash up to a distance of 3,000 miles. A sub-commission held under the presidency of Dr. H. Norinder expressed the opinion that all investigations on the physical processes of lightning discharges would be of value in the investigation of the nature of atmospherics, and recommended that optical and photographic recording of lightning flashes should be developed as much as possible in order to assist in this work.

Dr. van der Pol presided over the Commission dealing with Radio-Physics. Consideration was given to the study of the mechanism of the generation of electrical oscillations of ultra-high frequency, and to the propagation of the corresponding ultra-short waves. Investigations of the theory of propagation and absorption of waves in the atmosphere were reviewed and it was considered desirable to extend the study of the theory of non-linear oscillations. Another matter which the London meeting of the U.R.S.I. has set down for further investigation is the inter-action of radio waves in their passage through the ionosphere. Dr. van der Pol presented an interesting summary of the experiments already made on this phenomenon, including an observation made in Holland of a 'cross-modulation' effect between Athlone in Ireland, and the new high-power broadcasting station at Droitwich.

Apart from the business meetings of the congress, the delegates visited the Radio Department of the National Physical Laboratory at Slough and Teddington, the Rugby and Baldock Stations of the Post Office, Broadcasting House, and the University of Cambridge. On the occasion of a reception at the Royal Institution, Sir William Bragg gave an experimental lecture on Michael Faraday, illustrated by some of the original apparatus used by Faraday. The delegates were further entertained by H.M. Government at a dinner at Grosvenor House, at which Sir Kingsley Wood, Postmaster-General, presided. At the closing session of the General Assembly, it was announced that Prof. E. V. Appleton had been elected president of the U.R.S.I. in succession to Prof. A. E. Kennelly, who has retired on the grounds of ill-health. The next plenary congress is expected to take place abroad in 1936 or 1937.

Planning and Economics

AT the recent Aberdeen meeting of the British Association, several interesting papers were contributed to a discussion on "Economic Planning" arranged by Section F (Economic Science and Statistics). In opening the discussion, Prof. D. H. Macgregor, of Oxford, said that the problem to be considered is the case of private enterprise versus the control of private enterprise. While it is admitted that mistakes and waste occur under private enterprise, yet under planning any mistake that is made would be much more serious and might involve very great losses and waste. From an examination of the records in Somerset House of joint stock companies, it has been found that 60 per cent of the companies formed over a certain period were dead in ten years, that less than 30 per cent survived twenty years and only 18 per cent survived for 40 years. This is a high mortality and indicates the risks involved. In money, the wastage amounts to about forty-four million sterling a year or one or two per cent of the national income of England and Wales at the time. A sixth of the year's savings was offset by the dead loss involved. These figures indicate that, under planning, the risk of loss which would result from serious mistakes is very great indeed.

Deprecating dramatic talk about a new order of things, Prof. Macgregor held that what is really required is to work our way gradually into a higher and better organisation of competitive industry such as would have worked itself out if the War had not taken place. There has been much talk about President Roosevelt's "New Deal", but it should be remembered that in Britain we dealt these cards long ago. For example, the Trade Board legislation dates back to 1909 and our social insurance scheme to 1911. America is not so much giving a new deal as dealing in a hurry.

Sir Josiah Stamp, who followed, stated that he felt that the change now going on is rather greater than Prof. Macgregor was prepared to admit. There is, he said, an instinctive feeling at the present time among many persons that unco-ordinated individualism has given rise to maladjustments, since under it every individual conducts his business entirely within the limits of his own estimations of the market, with resultant mistakes. When we have all these individual business judgments being made, the total supply forthcoming is practically accidental. The consequence of mistaken judgments has now become too serious for others to put up with it lightly. Therefore we are told that it is impossible to go back to the muddle of individualism. On the other hand, the technique of planning is likely also to lead to a muddle, and the question is, which muddle are we going to deal in ? Most persons to-day would seem to hanker after the middle line between unrestricted individualism and complete national planning. He agreed with Prof. Macgregor that if we do plan and make mistakes, then we shall be faced with something worse than we had under individualism. A solution cannot be found by imposing fixed prices on the community, since the more this is attempted, the more likely we should be to have the reactions which were prevalent during the War period. The possibilities of making profits must be there, for we cannot revive industries by sitting on the mainspring. If there were no profits—whatever form these may take—the industry would have to be subsidised by the community and would become merely parasitic.

Prof. W. F. Bruck, formerly of the University of Münster, maintained that planned systems which aim at excluding the market, with its free play between private undertakings, in favour of the State as leader of the national economy, exist only in theory. Even in Russia, such domination of the economic sphere is limited in the home market by capitalist methods and in the world market by the price mechanism of the liberal economy. However complete the socialist planned economy may be, it cannot eliminate risk ; it can only transfer it from private enterprise to the State. The forces of economic life, like the forces of Nature themselves, can only be influenced, not absolutely controlled. Complete abolition of the market is impossible and any attempt to submit the complex organisation of modern trade to regimental discipline is hazardous. These obstacles and our present incomplete knowledge of them will compel those who strive to exclude the market from their planned economies to re-invent the market that they have eliminated. To-day, no State shows either a perfect liberal economy or a perfect planned economy, but all show invasions in the economic sphere. The economy of our States is a mixture of both capitalism and socialism, and they only differ in the degree of the intensity of this mixture, ranging from present-day England through America, Germany and Italy to Russia. In advocating the formation of industrial units similar to the German 'mixed enterprises', which provide a compromise between public and private control, Prof. Bruck suggested that whole trades might be controlled in this way either in groups, cartels or co-operative societies. The 'mixed enterprise' combines the advantages of private organisation, which avoids red tape and politics, with those of State participation, which ensures proper consideration of the interests of the community.

Prof. A. Gray, of the University of Aberdeen, said that while he is not necessarily opposed to planning, it is difficult to know what exactly it is all about. Let us admit, he said, that planning may in certain cases bring health to an industry by the elimination of useless units and by the rationing of supply at such a level as would enable a profitable price to be exacted. But does this bring us any nearer to the ultimate solution of the problem ? It may merely result in placing the members of a particular industry in an advantageous position. There might be 'cut-throat' competition between different industries just as much as between different units in the same industry. Most industries are competing against each other for the favour of the consumer. Short of making people consume according to plan, nothing would prevent changes of tastes and desires ; men are inconsistent ever and women are a great deal more. One element of uncertainty in long-distance planning is the possibility of variation with regard to population. Thus the United States appears to be approaching a stationary stage and in many respects they have built for a larger population than they are likely to achieve. If the State be the planner, it must have a population policy. A planned State demands planning, not merely in industry, but also in all the diverse elements of national life.

Physical and Chemical Properties of Heavy Water

IN the recent joint discussion of Sections A (Mathematical and Physical Sciences) and B (Chemistry) on September 10, at the British Association meeting at Aberdeen, on heavy hydrogen, two points of some interest were referred to by those taking part. During the last two years, the experimental confirmation of the theoretical anticipations of the differences in behaviour, both physical and chemical, of the two hydrogen isotopes has proceeded at a remarkable speed. In the course of these investigations, in which both light and heavy hydrogen have been employed under similar conditions, it has been found possible to examine by isotopic labelling of the hydrogen atoms in a molecule a certain number of what may be termed exchange reactions.

The two simplest exchange reactions involve reactions between the gaseous isotopes themselves and between deuterium and water

$$H_2 + D_2 \rightleftarrows 2HD$$
$$H_2O + D_2 \rightleftarrows DHO + HD$$

In the catalytic hydrogenation of unsaturated organic compounds, such as ethylene or benzene in the presence of nickel or platinum as catalyst, the experiments on the replacement of the hydrogen by deuterium not only provide a confirmation of the view originally advanced by Sabatier that a metallic surface monohydride is the effective catalyst, but also reveal the interesting fact that exchange reactions occur and that these can proceed independently of the process of hydrogenation, namely:

$$C_2H_4 + D_2 \rightleftarrows C_2H_3D + DH$$

Whilst the energetics of these reactions have not been investigated in great detail, the qualitative evidence indicates that the energies of activation are small, suggesting that the reactions are brought about not so much by an unexpected fragility in the covalent link between carbon and hydrogen when the hydrocarbon is adsorbed, but rather by a species of atom interchange between adsorbed atoms, one being attached to the hydrocarbon, a mechanism similar in some respects to the *ortho-para* conversion in hydrogen effected by hydrogen atoms. Incidentally, our crude picture of the interactions which occur when a molecule such as ethylene is adsorbed on a nickel surface has to be modified to a very considerable extent, and also the migration of double bonds in complex organic compounds in the presence of such hydrogenating catalysts may merit thorough investigation.

Deuterium thus provides us with a tool to examine exchange reactions, some of which as we have seen are not only of a somewhat unexpected nature but also could not have been discovered by the ordinary methods of investigation. In addition, deuterium is proving of great value in assisting us to elucidate the mechanism of a number of chemical actions involving hydrogen.

Such reactions may involve participation of hydrogen atoms, hydrogen molecules or unstable intermediary compounds of hydrogen, for example, O_2H in the hydrogen-oxygen reaction or NiH in hydrogenating reactions at a nickel surface. By suitable experiments, it is possible to examine the changes both in the velocity and in energies of activation caused by the replacement of hydrogen by deuterium, and from such data to determine, sometimes uniquely, in other cases by elimination, which is the rate-governing step in the reaction mechanism and which of the three possible participants enumerated above is actually involved in this step. In this way, it has been found possible to confirm that the mercury photosensitised reduction of nitrous oxide takes place through an atomic mechanism, that the rate of the photochemical combination with chlorine is governed by the link involving a hydrogen molecule:

$$H_2 + Cl \rightarrow HCl + H;$$

that the mercury photosensitised reduction of ethylene does not proceed through a chain mechanism; and that the chain mechanisms of the thermal combination of hydrogen with nitrous oxide and oxygen differ in that in the former a hydrogen atom is involved in the slowest link reaction and in the latter either a hydrogen molecule or a compound such as O_2H. Further information on the zero point energies of such complexes may permit of a decision between these two possibilities.

It was evident from the discussion that, quite apart from the more sensational and, at present, much more mysterious action of compounds of heavy hydrogen, especially water in biological processes, the new isotope provides an extremely effective weapon with which to extend our knowledge of the mechanism of the reaction kinetics of what are generally regarded as simple systems. E. K. R.

Hydrogenation of Coal in Germany

THE partial conversion of coal into liquid fuels by treatment with hydrogen gas under pressure at high temperatures is a technical process which is finding application in Great Britain, and a description of the method as used in Germany, given by F. Rosendahl (*Die Naturwissenschaften*, 33, 554; 1934), is therefore of interest.

The development of the original process due to Bergius has been brought to a successful stage by the I. G. firm. The conditions for operation require that the reaction should be accelerated by suitable catalysts and that the sulphur, nitrogen and oxygen of the coal should be set free and united with hydrogen. The design of apparatus which could resist the action of sulphur and hydrogen under high pressure was also a difficult problem. As catalysts, the sulphides of iron, tungsten and molybdenum have been adopted, but the physical state of the contact mass is of great importance. In this way, two-thirds of the coal is converted into light liquid hydrocarbons, and it is possible to produce illuminating oil from coal.

The process occurs in two stages. In the first, the carbon compounds are decomposed and the carbon converted into hydrocarbons. This stage is practically quantitative, 15 per cent of gaseous and 85 per cent of a mixture of low and high boiling oils being formed. This stage is operated with a paste of

dried and powdered brown coal and oil under a pressure of 200 atmospheres in contact with hydrogen, the reaction chambers being tubes 18 m. long, 0·8 m. diameter, and with walls 13 cm. thick. The materials are heated to a temperature of about 500° C. The liquid product is then distilled, and heavy oil (used in mixing with the coal), petrol (benzine) and middle oil obtained.

The middle oil then undergoes the second stage of the treatment. It is again brought in contact with hydrogen under 200 atm. pressure, the whole mass being heated so that it becomes gaseous, and the reaction is allowed to proceed in a furnace, no details of which are given. The gaseous and liquid parts of the cooled product are separated, the excess of hydrogen being previously taken off under pressure. The liquid is distilled and the middle oil obtained again undergoes treatment.

The process is said to be capable of producing lubricating oils as well as petrol. About 20 per cent of the carbon of the coal is recovered as gaseous hydrocarbons (methane to butane), which may be used as such or converted into chemical compounds. Propane and butane are fairly easily liquefied, and can be used for lighting and heating. Such gases are used in the motors of 'zeppelins'. The gases may also be converted into hydrogen by reaction with steam.

In the hydrogenation process, which is strongly exothermic, the control of the temperature is very important, and the whole process must proceed within a narrow zone of temperature. If this is allowed to be exceeded, the temperature rises very rapidly and the reaction vessel may burst. To prevent attack of the steel vessels by sulphur, they are treated with zinc vapour, which produces a diffusion layer of iron-zinc mixed crystals. The vessels themselves are of chromium-nickel steel, containing vanadium, molybdenum and tungsten.

The whole process is one of considerable interest and importance, and possesses obvious advantages—apart from costs, which are not dealt with—over petroleum cracking, since the latter process does not produce lubricating oils of any value from the crude oil and also leaves a considerable proportion of coke.

University and Educational Intelligence

CAMBRIDGE.—The Frank Smart studentship in botany is vacant. Any graduate of the University is eligible provided that not more than fourteen complete terms have elapsed after the first term of residence. The value of the studentship is £200, and candidates' names should be sent to Prof. A. C. Seward at the Botany School before October 2. Candidates should submit a statement of the course of research it is proposed to undertake and such evidence of qualifications as they think fit.

ST. ANDREWS.—The date of the installation of General the Right Hon. J. C. Smuts as rector of the University has now been definitely fixed as October 17. The Senatus Academicus has resolved, on the occasion of the installation, to confer the honorary degree of LL.D. upon the following, among others: Sir Thomas Holland, principal of the University of Edinburgh; Mr. John Hutchinson, of Kew Herbarium; General the Right Hon. J. C. Smuts.

A COURSE of evening lectures on television will be given on Thursdays, commencing October 4, by Mr. J. J. Denton, at the Borough Polytechnic, Borough Road, London, S.E.1. The syllabus and further information can be obtained from the Principal of the Borough Polytechnic.

ACCORDING to the Berlin correspondent of the American Medical Association (*School and Society*, Feb. 17), German universities should be fortified against the debilitating influences of departmentalism and high specialisation by reforms recently decreed by the Prussian Minister of Public Instruction. A candidate for appointment to an instructional post will in future be required to have served several months in a field station or work camp in which conditions are such as to test his virility. Only after undergoing this test with credit will he be admitted to the *Dozentakademie*. Here, participating in a strictly organised community life while pursuing courses of a general scientific character, he will have to prove his worth in fields outside his specialty and will be expected to develop the general impulses requisite for the instruction of youth in the Germany of to-day. Lastly, he will be examined as a specialist. All this involves a radical breach with the tradition according to which the appointment of instructors used to be left to the unfettered discretion of the department, if not to a single member of it, with the result that candidates were selected for their scholastic attainments within their chosen special field without regard to their general qualifications. The *Dozenten* have, moreover, been organised as a society with bureaux which will deal, *inter alia*, with questions pertaining to reforms in curricula and the privileges of Germans who have emigrated to foreign countries.

Science News a Century Ago

A Lecture on Animal Physiology

Lecturers who dealt with the more popular aspects of natural science had, in early times, to consider the moods and composition of their audiences. Although no actual censorship existed, it was not deemed desirable to invest a discourse in physiology or in botany with too full details respecting the processes of function, for there was a risk of offending current established and entrenched habits of thought. The *Analyst*, in reporting a lecture on "Animal Physiology", delivered on September 29, 1834, by George Sheward, before the Worcestershire Literary and Scientific Institution, made the following comments:—"Mr. Sheward made choice of 'Animal Physiology' as the ground work of his lecture, and it becomes our duty to speak of it as a composition written for oral delivery. We wish it to be clearly understood that we do not entirely object to the peculiar matter chosen for the lecture. . . . The great difficulty however, suggested to our mind, was, how to steer clear of those technical explanations which are necessary to unfold the history of the animal economy, without trenching on the delicacy and fastidiousness of the auditors, one half of which possibly were females—but we are bound to say Mr. Sheward very dexterously contrived to throw becoming drapery over this department of his scientific research, and adapted it to the ears of the sensitive and the scrupulous. There can be no doubt

that the lecturer stripped much professional detail—but some downcast looks from the sisterhood convinced us that he had not pruned quite enough. In truth, although unwilling to check the progress of science, we begin to think that some very peculiar subjects, such as, 'the digestive and other organs, midwifery', etc. had better be confined to the lecture rooms of the hospital."

Distilling Water for Ships

The simple process of obtaining a supply of fresh water in ships by distillation only came in after a long series of experiments, and a century ago men-of-war still obtained their fresh water from shore. "Casks were landed, rolled up the beach, filled and rolled down the beach, and 'parbuckled' into the launches." Yet, so early as 1593, Sir Richard Hawkins had a distilling apparatus in his ship, and in 1762 Dr. Lind showed the Royal Society how fresh water could be obtained from sea water. One experiment just a century ago, on September 29, 1834, is recorded in the *Times*. The apparatus was the invention of Mr. Wells and the experiment was made in a vessel moored for the occasion alongside "Carey's floating bath off Westminster Bridge". The experiment was entirely successful, and was watched by several naval captains and other persons interested in shipping. "The apparatus itself is in height about 4 feet 6 and in breadth and length about 4 feet. It is a steam kitchen calculated to supply the place of a galley and caboose, and capable of cooking for 70 or 80 persons. It weighs about 11 cwt. and consumes in 12 hours about 2 cwt. of coal. It purifies sea water at the rate of a quart a minute; the steam or distilled water is condensed with great rapidity by means of a pipe or tube through which it passes being carried along the outside of the bows and side of the vessel, and brought into immediate contact with the ocean, by which means it is rendered immediately cool; the pipe re-enters the vessel and the fluid drops from it as from the worm of a common stile. This simplification of the process of condensation appears to be the principal novelty, and it is not the less valuable for its simplicity of contrivance."

Washington and the American Philosophical Society

At a meeting of the American Philosophical Society held on October 3, 1834, the librarian presented the original reply of General Washington to an address sent to him as one of the members of the Society in December 1781, on the occasion of the capture of Lord Cornwallis. In his letter, which was addressed to Dr. Thomas Bond, a vice-president, Washington said: "Permit me through you, to return my warmest thanks to the American Philosophical Society, for this very polite mark of their attention and esteem. I have ever set the highest value upon the honour which was conferred on me, when admitted into a Society instituted for the noblest of all purposes, that of 'promoting useful knowledge' and have long wished for an opportunity of rendering myself, in some degree, worthy of my election. Happy am I, therefore, in receiving this public assurance from Fellow members, that my Services, upon a late important occasion, have contributed to give them an additional security in their pursuit of Science. . . ." The minutes of the Society recording the election of Washington as a member having been lost, it was ordered that the letter be entered in the minutes.

Societies and Academies

PARIS

Academy of Sciences, August 6 (*C.R.*, 199, 393–444). H. DESLANDRES: A simple and general relation of the molecular spectrum with the electrons and rings of electrons of the constituent atoms. SERGE BERNSTEIN: The absolute convergence of trigonometrical series. A. BIGOT: The Bathonian reefs of Normandy. SAUVEUR CARRUS: The trajectories of the meridians of a surface of revolution. THADÉE PECZALSKI: Study of the internal radiation of the electric arc. L. COLOMBIER: The variation of the electrolytic potential of nickel with the acidity. PAUL CORRIEZ: The X-ray diagrams of various peranthracites and true anthracites. MLLE. ELLEN GLEDITSCH and ERNST FOEYN: The actinium-uranium ratio in radio-active minerals. From the examination of seven minerals from different sources, the value 0·128 is deduced for this ratio. PIERRE AUGER: Absorption measurements of the γ-rays by the method of coincidences. The case of the radiation of excited beryllium. ANDRÉ DE PASSILLÉ and MARIUS SÉON: The thermochemistry of the ammonium phosphates. HENRI TRICHÉ: Quantitative spectrographic analysis: application to silicon. LOUIS MÉDARD: New results on the Raman effect of the hydroxyl radical. Data are given for formic acid, monochlorhydrin, glycol, hydroxylamine and glycerol. MME. SIMONNE ALLARD: The structure of a paraxylylene. YVES RAOUL: A new technique for the determination of hordenine. MARCEL MATHIEU and CONSTANTIN KURYLENKO: Remarks concerning the absorption of acetone by the nitro-celluloses. Discussion of the effects of the presence of traces of water during the absorption of acetone by the nitrocellulose. ANTONIN LANQUINE: The structure of the Provençal chains in the north of the eastern Varois region. PAUL CORBIN and NICOLAS OULIANOFF: Aerial photography in the service of geology. An account of work done in the Alps. JACQUES FROMAGET: New observations on the age and structure of the oldest sedimentary and crystalline formations to the north of Tonkin. PAUL SELTZER: The influence of a forest on the temperature of the air. Discussion of continuous records of temperature carried out in the forest of Haguenau (Bas-Rhin) with the view of determining the influence of the forest on the temperature of the air. PAUL BERTRAND: Observations on the classifications of the true Pecopteris. AUGUSTE and RENÉ SARTORY, JACQUES MEYER and HANS BÄUMLI: An attempt at differentiating between the parasitic cellulolytic fungi of paper. Comparison of the action of *Cladosporium, Fusarium* and *Aspergillus* on pure cellulose, with special reference to the effect of the culture media added. LÉON BINET, M. LAUDAT and J. AUCLAIR: The lowering of the alkaline reserve and the movement of the chlorine in the blood in the course of hyperthermia produced by short waves. The rise of temperature produced by short waves (15–18 metres) leads to a fall in the alkaline reserve of the blood plasma accompanied by a slight increase in the proportion of chlorine in the plasma and a slight fall in the number of corpuscles.

Academy of Sciences, August 13 (*C.R.*, 199, 445–468). LOUIS DE BROGLIE: The wave equation of the photon. A. C. MUKHERJI: Continued functions possessing a perfect ensemble of singularities, everywhere discontinuous. GEORGES ALLARD: A general method of statistics applicable to groups of indiscern-

ible particles. JACOB J. BIKERMAN: The velocity of the establishment of potential. MME. LUCIE LEFEBVRE: The suppression of certain bands of the spectrum of ozone under the action of low temperature. A diagram is given showing the ultra-violet absorption bands at 20° C. and −80° C. RADU TITEICA: The absorption and fluorescence spectra of some hydrocarbons with two benzene rings. JEAN BOUCHARD: The influence of viscosity on the decrease of fluorescent power of solutions of certain colouring matters as a function of the concentration. CAMILLE LEFÈVRE and MAURICE RANGIER: The oxidation of organic sulphur applied to its determination. Organic sulphur can be determined by wet oxidation if the sulphur is not united to oxygen in the molecule. The presence of the SO or SO_2 groups confers a power of resistance to oxidation in solution. LOUIS MONTLAUR: Climate and the physical wants of the plant. Means of comparing them. B. S. LEVIN and C. PIFFAULT: Variations observed, following subcutaneous injections of colloidal lecithine in the guinea-pig, in the radio-resistance of its red blood corpuscles *in vitro*.

GENEVA

Society of Physics and Natural History, May 3. W. H. SCHOPFER: The technique of the preparation of extract of wheat for the study of the growth factor of micro-organisms. The author has studied the mode of preparation of the extract of the wheat germ containing the growth factors of the micro-organism. The method based on the precipitation of the active factor by phosphotungstic acid gives good results. A technique based on the elimination of the proteins by trichloracetic acid can be substituted. The final product, however, has lost part of its activity, some of the factor having been absorbed by the precipitated protein. E. MOLLY: Observations on the rocks of Abyssinia (1). The author has studied the problem of the relative age of the volcanic formations. G. GUTZEIT and R. GALOPIN: The chemical differentiation by the spot method on a polished surface of some similar sulphosalts. G. GUTZEIT, R. WEBEL and R. DÜCKERT: A new specific reaction for antimony cations. One of the condensation products of the hydroxyl derivatives of benzene has proved to be a remarkably specific colour reagent for the antimony cation. The exact constitution of this derivative has not been established. P. WENGER, G. GUTZEIT and TH. HILLER: A method of electrolytic attack of opaque minerals and its application to the technique of etching polished surfaces. The authors have found an extension of the method of etching allowing the elements to be identified directly starting with the insoluble minerals, through the action of the electric current (application of the Glazunov method to the polished surfaces of opaque minerals).

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 2, No. 4). I. P. NATANSON: On the convergence of series of orthogonal polynomials. B. DAVYDOV: The Fokker-Planck equation in the phase space and the relaxation period of the Maxwellian distribution. L. I. MANDELSTAM: The problem of the diffusion of light in an unequally heated space. L. V. MYSOVSKII and M. S. EIGENSON: Observations on the neutrons from cosmic rays in Wilson's chamber. Following Locher's work (*Phys. Rev.*, 44, 779; 1933) the authors obtained tracks from one to fifteen centimetres long of heavy particles. M. SAVOSTJANOVA and A. TOPOREZ: Formation of centres in the crystals of halogen-silver salts. R. E. ALBRANDT: Theoretical basis of the design of instruments for measuring temperatures. V. V. ALPATOV and O. K. NASTJUKOVA: Increase of the toxicity of quinine under the influence of the short ultra-violet rays. The toxicity increased by 20 per cent. A. V. FROST and M. I. SHAPIRO: Nature of the active spots of catalysts. It is suggested that the catalytic activity is connected with those points of the catalyser at which its crystalline structure is damaged. V. N. ORECHOVITCH and N. V. BROMLEY: Histolytic properties of the regenerating blasteme. An increased decomposition of proteins, due to the hystolitic properties of blasteme, takes place in the tissues of the part of the organ beyond the regenerating part. E. A. STERN and A. S. KRIVSKIJ: The action of metals at a distance on the structure and development of *Bacillus mycoides*, Fl. Heavy metals placed at 0·5–2 mm. from the colony of the bacilli depress the formation of spores. N. V. NASONOV: The structure produced in the axolotl by the subcutaneous insertion of a destroyed regeneration bud. L. S. BERG: A note on *Culter recurviceps*, Rich. (Pisces, Cyprinidæ). A Chinese species known under that name is discussed, and a new name *Erythroculter macrophthalmus* is offered for the Formosan fish determined as *C. recurviceps* by Tanaka. B. K. STEGMAN: Contribution to the phylogeny of the genus *Nucifraga*. The genera *Nucifraga* and *Cyanocephalus* represent a natural group, which must have originated in the ancient continent which existed in the Bering Straits.

ROME

Royal National Academy of the Lincei, April 22. U. CISOTTI: Determination of an analytic function. G. SCORZA: A certain real algebra of the fourth order. G. BRUNI and G. NATTA: Structure of unstretched rubber studied by means of electron rays. Unstretched rubber shows a non-crystalline structure when examined with X-rays, but when very thin laminæ are investigated by means of rapid electron rays, an orientated structure is revealed. The hypothesis that the molecules of rubber in thin, unstretched sheets are arranged in a contracted, spiraliform manner must be abandoned. P. ALOISI: Questions concerning the geology of Tuscany, particularly of Elba (1). A. TONOLO: The sine theorem for triangles traced on a surface. C. SEVERINI: Parseval's formula. E. BORTOLOTTI: Geodetic references along several lines in varieties with allied connexions. G. CALAMAI: The canonical system of a class of differential equations of the second order with periodic coefficients. MARIA PASTORI: The equations of the mechanics of non-Euclidean isotropic media. G. D. MATTIOLI: The dynamic theory of turbulence. B. FINZI: Integration of the indefinite equations of the mechanics of continuous systems (1). T. FRANZINI: The action of an external electric field on hydrogenated metals. E. AMALDI: Effect of the electric field on the limits of the absorption series of potassium. E. SEGRÈ: Effect of the electric field on the absorption series of sodium. C. ANTONIANI: New method of preparing xylose from maize cobs. Increased yields of xylose, with only slight formation of humous substances, are obtained by hydrolysing the cobs with 0·1 per cent nitric acid solution. Subsequent concentration in a vacuum results in the expulsion of most of the acid. V. CARMINATI: Cariometric determinations on the livers of rats bearing tumours in various stages of development.

Forthcoming Events

INTERNATIONAL UNION OF PURE AND APPLIED PHYSICS, October 1–6. Sessions on the solid state and on nuclear physics respectively.

Tuesday, October 2

At the Royal Institution, Albemarle Street, London, W.1.
At 10–12.30.
Sir William Bragg: Opening survey and general statement. Dr. E. Hückel: "Aromatic and Unsaturated Molecules: Contributions to the Problem of their Structure and Properties." Dr. F. Hund: "Description of the Binding Forces in Molecules and Crystal Lattices on Quantum Theory (Valency and Coordinate Binding)." Dr. J. M. Robertson will present a table of atomic distances in organic compounds determined by X-ray analysis. Succeeding discussion to be opened by Prof. J. E. Lennard-Jones.
At 2–4.30.
Lord Rutherford: Opening survey and general statement. Prof. R. A. Millikan: "Cosmic Radiation." Prof. A. H. Compton: "A Study of Cosmic Ray Bursts at Different Altitudes."

Wednesday, October 3

At the Royal Institution.
At 10–12.30.
Dr. C. D. Ellis: "β-Ray Type of Radio-Active Disintegration." Prof. Guido Beck: "Theoretical Consideration on the Radio-Active β-Decay." M. and Mme. Joliot: "Artificially Produced Radio-Elements." Prof. E. Fermi will take part in the discussion.
At 10–12.30.
At the Royal Society, Burlington House, London, W.1.
Dr. A. Joffé: (*a*) "On the Cause of the Low Value of Mechanical Strength." (*b*) "On the Mechanism of a Brittle Rupture." Dr. E. Orowan: "The Rupture of Plastic Crystals." Dr. E. Schmid: "Plastic Deformation by Slip." Dr. W. G. Burgers: "Shear Hardening and Recrystallisation of Aluminium Single Crystals." Prof. G. I. Taylor, Dr. H. J. Gough and others will take part in the discussion.
At 2.30–4.30.
Prof. P. P. Ewald and Dr. M. Renninger: "The Mosaic Structure of Rock Salt." Prof. A. Smekal: "The Fine Structural Characteristics of Salt Crystals." Prof. E. N. da C. Andrade and Dr. C. H. Desch will take part in the discussion.
At 2.30.
Prof. P. M. S. Blackett: "Cosmic Rays and the Absorption of High Speed Particles." Prof. G. Hoffmann: "The Connexion between Cosmic Radiation and Atomic Disintegration." MM. Auger and Leprince-Ringuet: "The Latitude Effect." Prof. Rossi: "Some Results obtained in the Study of Cosmic Rays."

Thursday, October 4

In the Arts School, Cambridge.
At 2–4.30 and 5.30–6.30.
Dr. J. Chadwick and Mr. N. Feather: "α-Particles and Neutrons." Dr. J. D. Cockcroft: "Transmutations Produced by High Speed Protons and Diplons." Dr. M. L. Oliphant: "Transformation Effects Produced in Lithium, Heavy Hydrogen and Beryllium by Bombardment with Hydrogen Ions." Dr. H. R. Crane and Prof. C. C. Lauritsen: "Protons and Diplons." Prof. G. Gamow: "General Stability Problems of Atomic Nuclei." Prof. Max Born: "Quantum Electrodynamics."

Friday, October 5

At the Royal Institution.
At 10–12.30.
Prof. A. Goetz: "Experimental Evidences of Group Phenomena in the Solid Metallic State." General Discussion: Prof. M. Born, Prof. W. L. Bragg, Prof. C. G. Darwin and others.
At 2–4.30.
Report of the Commission on Symbols, Units and Nomenclature: Part I: Electric and magnetic quantities Part II: Thermodynamic quantities.

Saturday, October 6

At the Royal Institution.
At 10.
Communication from the International Council of th Unions concerning Dr. Hale's Committee on Instruments. Future work of the S.U.N. Commission.

Wednesday, October 3

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 3.– Prof. George Barger: Inaugural Sessional Address.

BRITISH MYCOLOGICAL SOCIETY, October 1–6. Annu general meeting at Norwich.
Dr. B. Barnes: "Variation" (Presidential Address

Official Publications Received

GREAT BRITAIN AND IRELAND

International Tin Research and Development Council. First Gene Report, 1934. Pp. 37. Miscellaneous Publications, No. 1: T Research and Development; an Address delivered to the Americ Tin Trade Association. By D. J. Macnaughtan. Pp. 10. Technic Publications, Series B, No. 1: The Properties of Tin. Compiled l Dr. E. S. Hedges and Dr. C. E. Homer. Pp. 45. (London: Inte national Tin Research and Development Council.)

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